Video in the Abyss

In the context of the digital, is analogue video feedback

still useful as an approach to making art?

Sam Meech

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ABSTRACT

Video feedback systems have been largely discounted by media artists in favour of digital tools and code-based programming languages, which offer a more robust, data-driven approach to developing generative and interactive moving image works. Furthermore, art historians have generally failed to document and reflect on the practice of video feedback. However, video feedback systems have many qualities that can enrich current digital culture, whilst digital tools provide an opportunity for artists to revisit analogue feedback from a fresh perspective.

This thesis and accompanying portfolio reappraises the use of feedback systems in media art, and explores their application in combination with digital tools such as projection mapping software. Through practice-based research, analysis of contemporary media art works, and interviews with artists and curators, this thesis identifies and analyses the key technological and experiential properties of video feedback installations from the perspectives of both artist and audience.

The works produced proved to be extremely engaging for audiences. Comments from experts within the field suggest that key factors include the mesmerising

elemental forms and textures of feedback, and the intuitive nature of the interface. One work (PORTALS) was also shortlisted for the Lumen Prize for Art and Technology.

Video feedback works still present unique problems: they are difficult to calibrate, often unpredictable or even unrepeatable. However, this thesis concludes that there are significant benefits in revisiting this 50 year old video art technique from a contemporary digital perspective. Digital video tools offer new ways to generate, calibrate, and present video feedback in various contexts. Conversely, the incorporation of optical or analogue feedback into digital systems can offer a simple method of generating complex textures and chaotic behaviour without the need for programming skills, as well as providing an extremely intuitive interface for audience interaction via the video camera.

The thesis ends by suggesting that more research needs to be done to examine how feedback installations can be made more robust and scalable across a range of contexts from white cube galleries to light festivals.

NOTE:

Additional supporting materials, including videos of the works produced during this research project, can be found online at:

http://videointheabyss.smeech.co.uk

I would like to thank my supervisors Clinton Cahill, Dave Griffiths, and David Jackson for their insight and encouragement. I would also like to thank Marilyn Farley for her feedback and support.

Contents

une mise en abyme
a picture in a picture
placed in an abyss

Chapter 0

INTRODUCTION

0.1 Introduction to the Introduction

This is the first sentence of a thesis about feedback loops in media art.

Video feedback was regarded by early video artists as 'the fire of the gods' (Furlong, 1983) for its powerful (albeit unstable) real-time generative properties. A simple looped arrangement of video camera and display produced a fascinating mise-en-abyme[1] of infinite real-time recursion - pictures within pictures. Careful manipulation of the camera allowed artists to gently push the video signal into abstraction, and coax a myriad of self-sustaining patterns.

Nevertheless, within a decade, video feedback and video synthesis were being written off by critics as "bad art" (Meigh-Andrews, 2014:134) - a practice too inclined to abstraction for an art world heading towards postmodernism. Artists began to adopt new tools for image generation, as analogue video was superseded

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[1] The phrase 'mise en abyme' literally means 'placed into an abyss'[†]. In the context of video feedback, it is often experienced as a television displaying the live image of a television, displaying the live image of a television, and so on. This arrangement, coupled with the latency of the video signal, creates a staggered visual repetition, but also a sense of depth, like an infinite corridor.

[†]The origins of the term derive from heraldry, wherein a coat of arms may have a smaller version of the same design placed within its centre. The term was adopted into modern criticism by Andre Gide to refer to any work of art or culture (be it an image or story) containing a smaller version of the work inside itself, suggesting an infinitely recurring sequence[ꝏ].

[ꝏ]Poet Ross Sutherland (2019) explores the concept of 'mise en abyme' in his 'Imaginary Advice' podcast episode of the same name. He cites various examples including early renaissance painter Giotto's 'Stefaneschi triptych' in St Peter's Basilica, and the advertisement for Laughing Cow cheese spread, which features a laughing cow wearing cheese triangle earrings, bearing the image of the same laughing cow:

"We might ask ourselves what is so god-damn funny? What joke could have possibly triggered this infinite fractal of cow laughter? But the answer is horrifyingly simple: the cow is laughing at the concept of a cow laughing... 'Mise en abyme' is essentially art that references itself. It is art about the consumption of art; kind of functioning as an instruction manual for its own use". (Sutherland, 2019: 2 min)

by the rapid development of computers. Today, digital software offers numerous approaches to the creation of generative animation and interactive installation, whilst galleries and museums have embraced digital video projection.

So what, in the context of all this rich digital weaponry, could video feedback possibly still have to offer artists today?

It is precisely because of video feedback's supposed irrelevance that this enquiry becomes necessary - firstly as a critique of technological assumptions (ie, 'new is better'), and secondly, in order to examine the properties of video feedback that make it different from digital tools and software.

0.2 Digital Artist, Analogue Tendencies

My work has often explored the interplay of digital processes and analogue media, or of old and new technologies. I like to 'feed-back' new processes into old media in order to discover new approaches. Whilst many of the tools I work with are digital (Isadora[2], a node-based video software, is usually my weapon of choice), I struggle with (or am not inclined towards) text-based programming environments or 3D design applications that form the basic tool kit for many contemporary media artists. I want to identify alternative hands-on approaches to generative art and interactive interfaces, that do not rely on the use of code-based programming languages.

[2] Isadora is an interactive video design software created by Mark Coniglio of Troikatronix (https://troikatronix.com). The graphical programming interface allows users to easily create dynamic video systems for interactive installation and live performance.

Though my work has often employed recursive structures[3] and live video systems, only on a few occasions have I used video feedback directly as a mechanism for generating or affecting the content of the work. Examples can be seen in my pieces 'A Long Journey' (2009), 'Moves 10' (2010, Figure 0.1), 'Video Culture - Staro Riga' (2014) and more recently 'Concrete Connexions' (2017) - all of which combine analogue video feedback with digital video processing tools such as Isadora. Though I've never fully understood the mechanics of video feedback, these few experiences have proved fruitful, hinting at further avenues to explore.

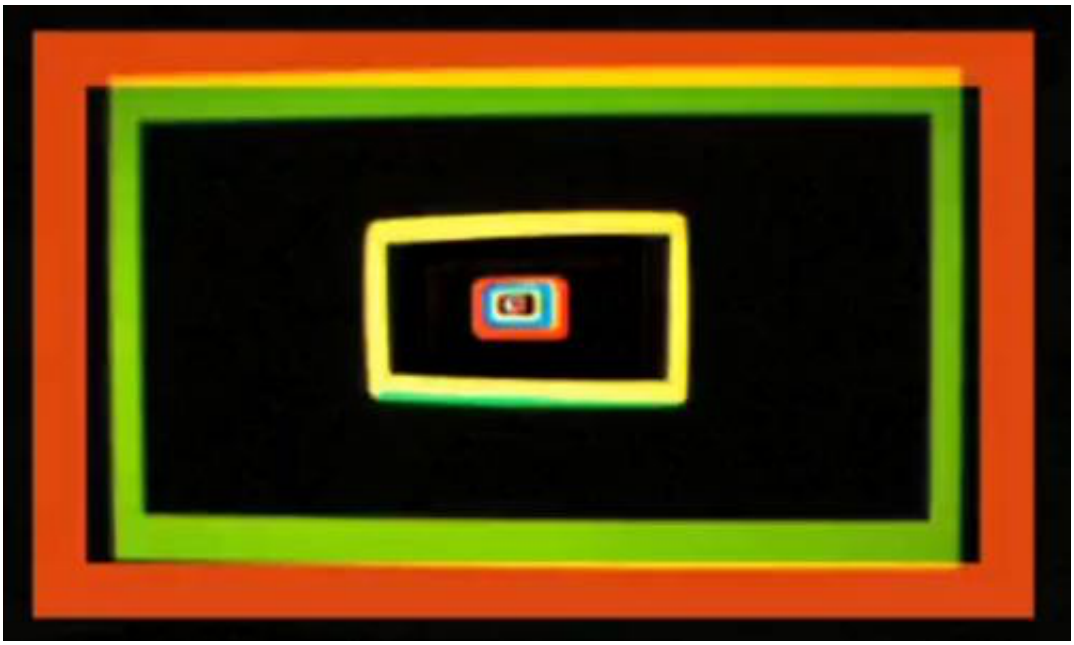

Figure 0.2.1 'Moves 10' (Meech, S. 2010)

[3] My proclivity for loops peaked in 2016, when myself and film programmer Chris Brown hosted a 24 hour marathon screening of 'Groundhog Day' (Ramis, 1993) at the Liverpool Small Cinema. We showed the film 12 times in a row, starting at 6:00 am on February the 2nd (Groundhog Day), and concluding at 6:00am the next morning. Only one audience member managed the whole 12 screenings. Last year, I again celebrated Groundhog Day, this time performing a live-streamed 'Triple Bill' VHS recursive remix along with sound artist Raz Ullah (2019).

0.3 Aims and Objectives

This project and thesis attempt to locate my work in relation to video arts practice historically, and identify the affordances and restrictions of working with analogue video feedback within media arts today.

I will not be looking at the *whole of* video art history but the *hole in* video art history. I will re-examine at the origins of video feedback, and address its apparent disappearance in art practice and art theory, before reviewing how practitioners today, working in the context of digital tools, incorporate video feedback as part of their practice. Furthermore, this project will practically demonstrate new ways in which video feedback can be combined with digital tools. I will do this by experimenting with video feedback techniques, video hardware and digital software, to create a series of original generative and interactive works. Finally, I will evaluate these practical experiments by gaining 'feedback' from experts working in the field of media arts.

0.4 Overview of the Structure

This thesis is split into two halves - **Order** and **Chaos**. Think of these as two sides of the same record, each with a groove that draws the needle towards a central departure point.

Side A of the record, **ORDER**, is a user manual to guide the reader through this recursive research project.

Chapter 1 provides a **contextual** overview by **Looping Back** to look at the origins, mechanics and terminology of video feedback. I will explore its many 'discoveries', addressing its disappearance from arts practice and arts discourse, before considering the impact of digital tools.

In Chapter 2 I will **Feed Forward** to the present day to examine the ways in which contemporary artists are working with video feedback, from pattern generation and infinity mirrors, to the resurgence of the video synthesis scene.

Flipping to Side B, **CHAOS**, the thesis will approach the subject through the refracted prism of **practice**, documenting and deconstructing my attempts to explore and apply video feedback in my own work.

Chapter 3 presents observations from my **Video Voyages** - open-ended experiments with optical feedback. I'll include documentation and brief reflections on these nascent loopy arrangements.

Chapter 4 unpacks my **Final Forms** - analysing three artworks, each demonstrating a different approach to working with feedback. The works were presented to a **Feedback Forum** - an expert panel of six artists and producers working with interactive digital installation and video. This chapter examines the key characteristics of each piece, as well as providing software and hardware schematics.

Finally, I will bring the chaos to a **Conclusion**, reviewing the findings and suggesting further avenues for enquiry. Since this is a special release, I'll provide extended liner notes in the form of a bibliography, along with additional schematics and documentation of the works.

0.5 Methodology

0.5.1 Parallel Systems

This practice-based research project utilises a parallel system of **contextual** and **practical** enquiry, employing both exploratory and evaluative approaches. Though some elements were finite (eg interviews with artists, Feedback Forum), other methods have been ongoing (such as the identification of current artists, and my practical experiments), continually reviewing and renewing both strands of the enquiry.

Contextual	**Practice**
• Reviewing video feedback literature	• Video Voyages - open-ended experiments
• Identifying contemporary practitioners	• Final Forms - realised works
• Interviews with practising artists	• Feedback Forum - user testing, discussion

0.5.2 Contextual

Reviewing Video Feedback literature

By researching historical uses of video feedback I was able to understand its impact on artistic practises, highlighting qualities that might still be relevant today. In reviewing writing on video art history, I tried to find those texts that

explicitly identified examples of video feedback use by artists[4]. The most insightful, reflective and technically comprehensive accounts have come from those authors with a practice in video - Meigh-Andrews' extensive 'A History of Video Art' (2014) discusses a number of practitioners, whilst texts from Bill Gwin (1971), Carol Goss (1996 - 2004) and Barbara Doser (2010) provide rich personal perspectives along with detailed technical explanations.

Identifying contemporary practitioners

In order to better understand the relevance of video feedback today, I have identified and analysed examples of contemporary practitioners working with the technique. As well as attending conferences, exhibitions and reviewing scholarly texts[5], online research and social media have proved particularly useful in highlighting current communities of feedback practise, both professional and amateur. Youtube, Instagram (#videofeedback tag), and the Video Circuits group on Facebook all host numerous examples of contemporary practice and discussion.

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[4] When researching artists working with 'video feedback', the signal to noise ratio is pretty poor. The varied uses of term 'video feedback' make it tricky to find those papers specifically addressing early video art practices. Today, the term generally refers to the practice of using video to record and review a subject in order to improve a system or process. This form of 'video feedback' is used in everything from psychology and education to medicine and sport. Thus, a catalogue search for 'video feedback' is much more likely to yield papers and articles relating to surgical knot tying procedures and improving your golf swing than how to generate fractals with your television. These uses of 'feedback' sit within the framework of Norbert Wiener's (1950) notion of Cybernetics and the 'control of a machine on the basis of its actual performance rather than its expected performance' (1989:24). In each case the intention is to improve some measurable aspect of performance in a system.

[5] Surprisingly few researchers have addressed feedback as an artistic strategy. Lars Bang Larsen (2018:124) though makes some great distinctions between negative and positive feedback systems in the context of counter-cultural movements. He compares the homogeneity of Wiener's cybernetic balancing act (negative feedback) with the amplified distortion and a-tonal guitar climax of acid rock (positive feedback). If negative feedback systems are about control, consistency and efficiency, then to create positive feedback is to reject control and instead embrace chaos, mutation and potential destruction. Notably he regards audio feedback as much more potent (or potentially violent) form than it's visual cousin: 'Feedback is the potential destruction of a system using the system itself. This may be true of audio feedback, but not so much video feedback'.

Interviews with practising artists

I have also conducted four in-depth interviews with contemporary artists about their conceptual and technical use of feedback. Whilst visiting Montreal, CA, in April 2019, I took the opportunity to speak to video artists Rob Feulner, Guillaume Vallée, Sonya Stefan and digital artist Daniel Iregui. Though I gained a fantastic insight from each, I have only been able include the briefest introduction to their work, as part of chapter 2 . To do them justice, the interviews will be developed separately in a future paper looking at Quebecois video artists.

0.5.3 Practice

Video Voyages - open-ended experiments

This first method references cognitive scientist Douglas Hofstadter's (2007) own improvisatory investigations with video feedback. These practical-yet-playful studies proved to be a rich model for developing his own ideas about self-reference in language, and the emergence of consciousness in humans. My own hands-on tests had more modest ambitions; to provide me with a technical understanding of the phenomenon of feedback, and inspire my thinking around the possibilities of incorporating it into new artworks. For each Video Voyage, I created a new technical arrangement (recorded as a schematic diagram), and noted my initial impressions in a journal, as well as capturing the resulting images. I returned to this method repeatedly throughout the research project.

Final Forms - realised works

Over the course of this project I have realised a number of prototype works for presentation and performance, developed over several iterations and configurations. I have chosen three of these works to examine in detail, outlining the hardware and software schematics, before reflecting on the challenges in

calibration, and evaluating the generative properties and opportunities for user interaction.

Feedback Forum - user testing, discussion

I presented five works for user-testing by an invited panel of six experts in the field - curators, producers and practising media artists. This was followed by a round-table discussion in which the panel were invited to reflect on their experience of engaging with the works. The discussion was audio recorded, and I have drawn on comments from the panel to develop my analysis of the works.

why don't they still do

the titles for Doctor Who

the way they used to?

Chapter 1

LOOPING BACK

1.1 What is Video Feedback?

Artists, theorists and scientists have provided some wonderful explanations[6] of video feedback, but for the purposes of this thesis, I want to define it in two stages. Firstly, it is the **process** of looping a video signal back into itself, from output to input. Secondly, this arrangement results in a range of complex **visual phenomena**. So, in the context of media art, 'video feedback' is both a *systematic arrangement of video technology*, and an *aesthetic object*.

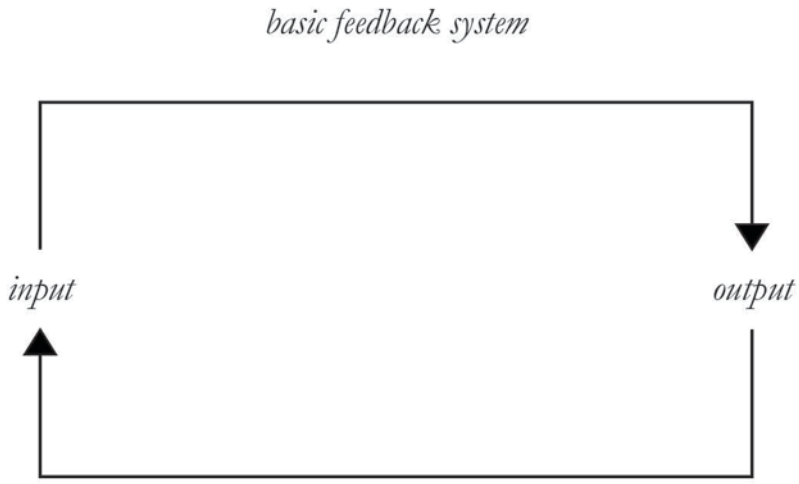

Figure 1.1.1 'basic feedback system', Sam Meech 2019

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[6] Bill Gwin (1971) begins his comprehensive feedback manual with a simple definition:

"Video feedback is produced by aiming a camera at a monitor; the camera actually takes a picture of itself. The patterns thus engendered can be altered in several ways, by exerting various controls over the electronics, and by affecting the optical path of the picture/monitor loop."

Some of the most insightful and creative explorations of video feedback have come not from art, but from science. Physicist James. P. Crutchfield (1984), described video feedback as a 'space-time analog computer'. He also details the transduction of the image between mediums:

"The camera converts the optical image on the monitor into an electronic signal that is then converted by the monitor into an image on its screen. This image is then electronically converted and again displayed on the monitor, and so on, ad infinitum" (1984:230)

Optical / External Video Feedback

A video feedback system can be created very simply by pointing a live camera at its own monitor in order to form a loop in the signal, resulting in an infinite visual echo of screens within screens - a mise-en-abyme[7]. With careful adjustment of the camera's position, zoom and iris, this arrangement can quickly produce 'wonderfully complex structures and patterns' (Hofstadter, 2007:70). I will refer to this use of a camera or lens-based input as **Optical Video Feedback**.

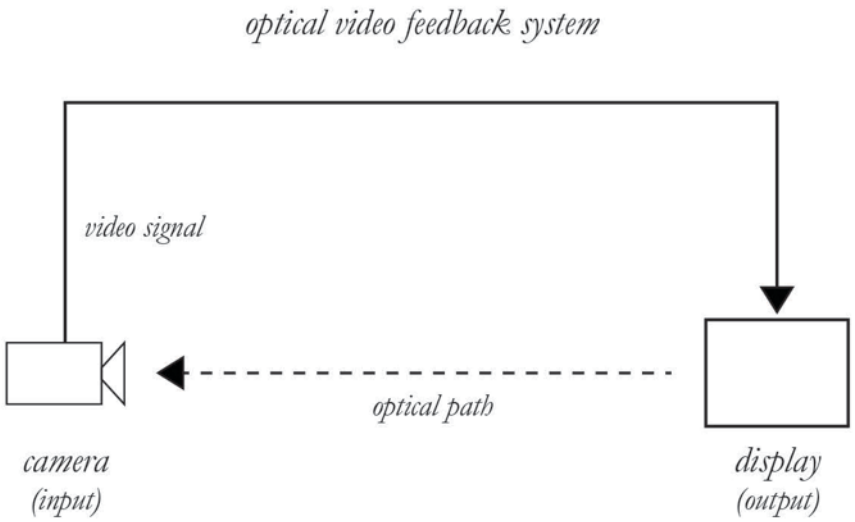

Figure 1.1.2 'optical video feedback system', Sam Meech 2019

[7] Kris Paulsen (2013) compares optical feedback to two opposing mirrors, but notes that 'each repeating image is a slice of time as well as space.' This is an important point, reminding us that video is a time-based medium, and that the any latency introduced by the feedback loop - even a single frame - entangles the visual and temporal echoes.

Figure 1.1.3 'optical video feedback - DSLR > mac', Sam Meech 2019

Sometimes the use of a camera is also referred to as External Video Feedback, since the signal loop is created *outside* the hardware, across physical space. As a result, a user can easily interact with the signal by placing themselves or an object between the camera and the screen, thus blocking light from reaching the lens, and interrupting the flow of feedback.

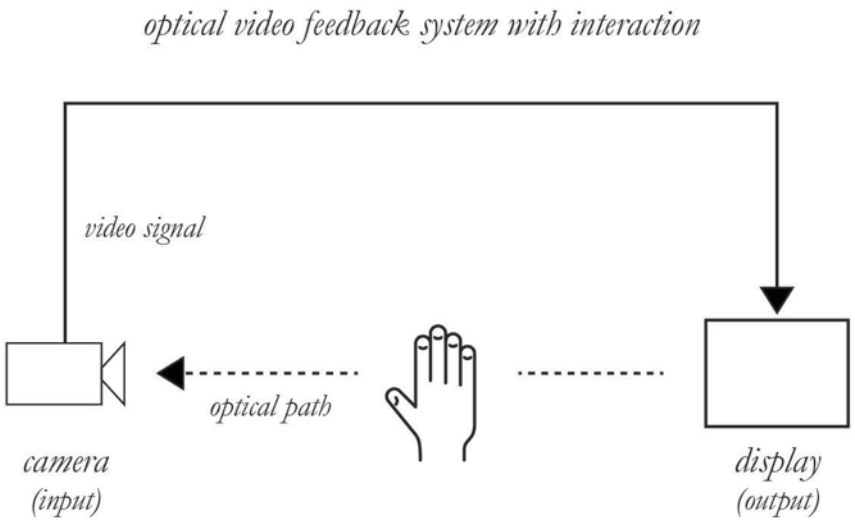

Figure 1.1.4 'optical video feedback system with interaction', Sam Meech 2019

Figure 1.1.5 'optical video feedback with interaction, Hi-8 > CRT', Sam Meech 2019

Internal Video Feedback

An alternative, camera-less approach is possible, by looping the video signal internally through a single (or series of) video mixers and / or video synths.

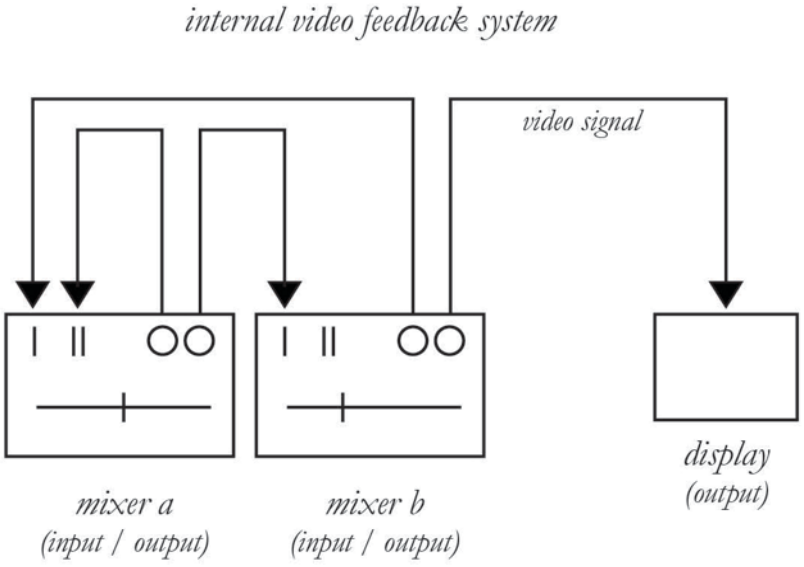

Figure 1.1.6 'internal video feedback system', Sam Meech 2019

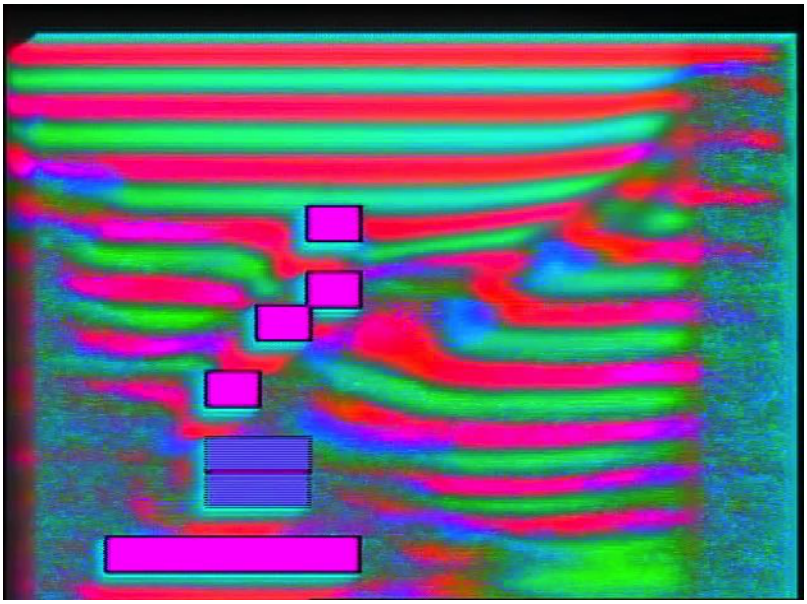

Figure 1.1.7 'internal video feedback - Panasonic WJ AVE5 > WJ-MX12', Sam Meech 2019

The output of a video mixer is routed back to an input, allowing it to be manipulated using the mixer's effects interface. A secondary output will usually go to a screen, displaying the effected feedback form. The patterns and forms - created without the use of a camera - are generated purely from the video signal and the circuitry of the mixer.

Multiple / Nested / Hybrid systems

Expanding on these basic configurations, a feedback system can quickly grow in complexity by adding more links to the chain, by nesting loops, or combining both internal *and* external systems. For example, a basic optical feedback loop can be doubled by adding a second camera and monitor in a daisy chain, or even several, thereby increasing the steps in the loop.

Alternatively an internal feedback loop using a pair of video mixers may also incorporate the output of optical feedback loop, or other sources of imagery, such as VCRs, or secondary projection sources such as film.

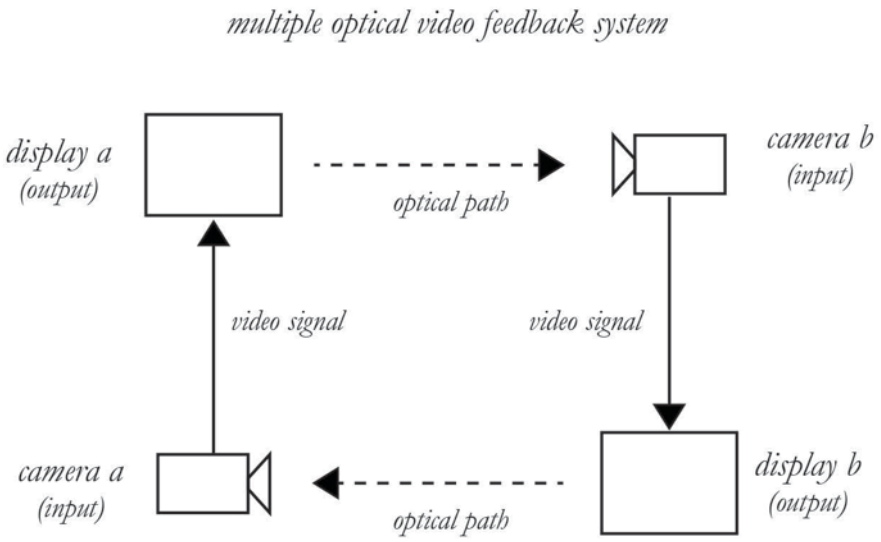

Figure 1.1.8 'multiple optical video feedback system', Sam Meech 2019

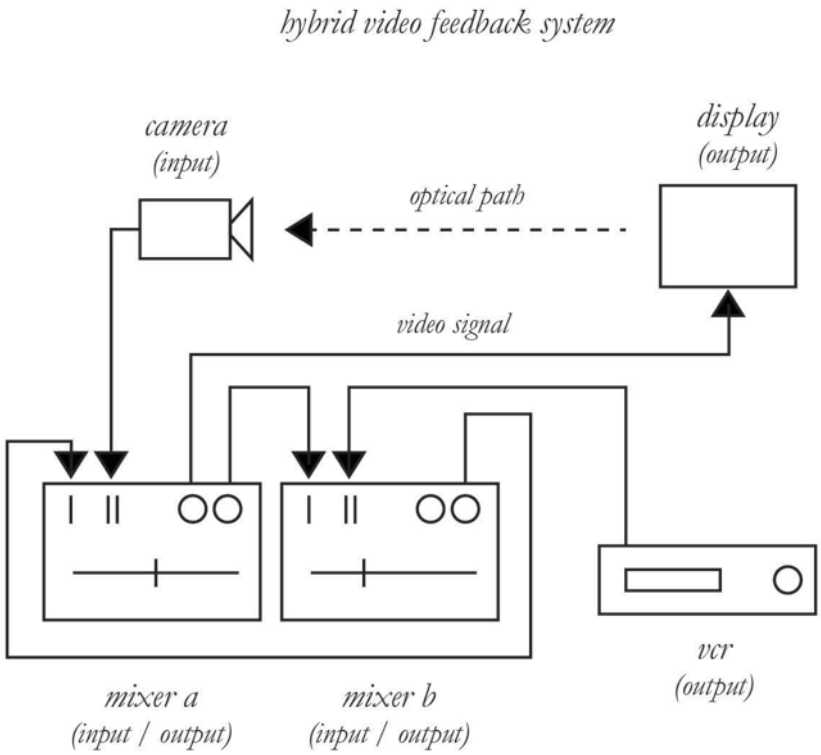

Figure 1.1.9 'hybrid video feedback system', Sam Meech 2019

If this sounds confusing, then don't worry, it is! Keeping a track of the flow of the video signal becomes exponentially difficult as the components and variables increase. Whilst it is useful to get a sense of how complex a system can become, at this point we just need to hold on to the basic principle of video feedback as a looped signal from output to input. The best way of course is to have a go yourself. For now, all we need is camera and a monitor.

1.2 Video Feedback as the Unearthly Child

On 20th August 1963, in Studio D of Lime Grove Studios, Shepherds Bush, London, three BBC technicians cautiously opened a rift in space-time. Title designer Bernard Lodge, Technical Operations Manager Norman Taylor, and camera operator Hugh Sheppard were filming the title sequence for a new science fiction show called 'Doctor Who'. The trio were experimenting with an unusual technique - nicknamed "howlaround" - by pointing a camera at its own monitor. Taylor, who had discovered[8] the effect whilst killing time in the studio, triggered the feedback by lighting matches in-front of the camera, whilst the resulting patterns were re-captured on 35mm film.

[8] There is still some debate as to who actually discovered the technique and produced the titles for Doctor Who. Though Bernard Lodge is officially credited as the title designer, BBC engineer Ben Palmer was also involved in its production. Meanwhile, Norman Taylor had previously experimented with the effect, by pointing a camera at monitor whilst killing time between shows. He submitted his findings and was eventually given a Technical Suggestion award of £25.

"I got the usual effect of diminishing images of the monitor disappearing into limbo when, suddenly, some stray light hit the monitor screen and the whole picture went mobile, with swirling patterns of black and white" (Hayward, 2011)

Figure 1.2.1 'Doctor Who - An Unearthly Child' (BBC, 1963)

Infinite visual echoes and shape-shifting forms were ideal for a show about time travel and extra-terrestrials. Coupled with an equally experimental electronic theme tune by Delia Derbyshire and the BBC Radiophonic Workshop, "howlaround" helped to make Doctor Who's title sequence one of the most enduringly iconic in TV history. The BBC had given birth to something truly alien. The arrival of the first episode on 23rd November 1963 - entitled 'An Unearthly Child' - was the perhaps the first time a mass audience had encountered video feedback[9].

Feedback was an otherworldly innovation borne of experimentation. It provided a quick method to generate complex, fluid forms, but its uncontrollable nature meant film stock was easily wasted. Howlaround was used for subsequent

[9] There is some suggestion that BBC engineer Ben Palmer (who also worked on Doctor Who) had used the technique for the BBC's broadcast of 'Amahl and the Night Visitors' in the summer of 1963. In any case, by the mid 70s, thanks also to the development of new video-processing tools, video feedback had nestled itself within pop culture as a startling visual effect for music videos. Iconic examples of technique include the opera section ("magnificoooooooo!!!!") of Queen's 'Bohemian Rhapsody'(1975:3mins 22) - and throughout Earth Wind and Fire's 'September' (1978).

iterations of the titles, until 1973, when it was ditched in favour of a new, much more precise technique known as 'slit-scan[10]' photography. Today the opening titles are completely digital, but still evoke similar forms, with Jodie Whittaker's name rendered against a cosmic Rorshach test of chaotic three-dimensional fluid dynamics. Feedback set the visual tone at the show's inception, and informed an aesthetic evolution that held over the decades, regardless of the technology.

Doctor Who may seem like an unusual starting point, but it provides a useful analogy for thinking about the changing use of video feedback within media arts practice. Could video feedback conceivably be revisited as a means to create the titles for Doctor Who? If not, why not? If we did, what would it offer? In the same way, why don't artists today use optical video feedback when it proved to be such fertile ground for early video practitioners? If they did, given the availability of digital tools, what would they create?

1.3 The Many Discoveries of Feedback

The precise historical origins of video feedback are unclear, though it is reasonable to assume that initial innovation came from technicians, like Norman Taylor, working in large organisations with access to specialist equipment. However, when artists finally got their hands on video - thanks in part to cameras like the Sony Portapak - they too were drawn to close the loop.

> The first thing everyone invariably did was feedback. This was the simplest and yet most amazing experience. To train the camera, slightly off-center,

[10] Slit-scan photography is a form of long-exposure stop motion animation, using light passing through a slit in an opaque mask. It was developed by John Whitney for the film Vertigo in 1958, but adapted to great effect by Douglas Trumbull to create the stargate sequence in Stanley Kubrick's '2001: A Space Odyssey' (1968). Like all stop-motion techniques, the process was very time consuming, but afforded Trumbull great control in producing the psychedelic images.

> on the monitor which was displaying the camera's signal was tantamount to creating life. (Goss 1998:2)

Artists inevitably explored and exploited feedback as a potent form of realtime image generation. Video artists Steina and Woody Vasulka have spoken about the myth of a singular origin, suggesting that the popular use of feedback arose from the fact video was ubiquitous.

> Video was the most shared, the most democratic art form. . . . Everybody believed deeply that he had invented feedback. Feedback was invented simultaneously not by five people, like electricity, but by five thousand. (Gill 1976:1)

Doser (2010:27) suggests that this sense of discovery brought with it a great affinity, citing an interview by Furlong (1983:13) with the Vasulkas, in which they reflect on their first encounters with this 'new' phenomenon.

> Our discovery was a discovery because we discovered it. We didn't know all those people had discovered it before us. It was just like feedback: pointing the camera at the TV set and seeing feedback was an invention that was invented over and over again. As late as 1972, people were inventing feedback, thinking they had just caught the fire of the gods.

Indeed, the simplicity and potency of feedback may also be one of its drawbacks, with artists caught in a cycle of reinvention. Video artist Bill Gwin (1971:4) warned against getting "caught up in the process of discovering it to the exclusion of anything else". Catching the fire of the gods is all well and good, but what are you going to forge with that fire?

The repeated accounts of finding feedback already suggest some important qualities:

1. There is an accidental aspect to encountering feedback - it is a **misuse** of technology, rather than a conventional production workflow.

2. This accident is **intuitive** - there is a universal compulsion[11] to point the camera at the screen.
3. There is an **attachment** between the artist and their discovery - a sense of ownership and awe.
4. There are many **further discoveries** to be made, beyond the initial discovery - new forms that can be elicited through play and careful manipulation.
5. The process of discovery and rediscovery may be fun, but it can be an unproductive loop; an Escheresque staircase to nowhere.

In summary, feedback must be approached as a voyage into the unknown. It is constantly being rediscovered, often by accident, by anyone who picks up a camera, leading to a great sense of attachment. Thus, one of video feedback's most important attributes for artists is the fact it is 'discovered' at all.

1.4 Feedback Theory in the Abyss

Gene Youngblood's 'Expanded Cinema' (1970) is a hugely important document of early video art practices as they were unfolding. Youngblood takes as much care in detailing technical specifics of works as he does in unpacking the theoretical implications. Since 'Expanded Cinema' however, there has been little continued attention given to properly documenting or deconstructing the practice of video

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[11] Cognitive scientist Douglas Hofstadter (2007:57) goes as far as to suggest this instinct to close the loop is both a primal taboo and an irrational intuition in humans.

"Feedback - making a system turn back or twist back on itself, thus forming some kind of mystically taboo loop - seems to be dangerous, seems to be tempting fate, perhaps even to be intrinsically wrong, whatever that might mean…These are primal, irrational intuitions, and who knows where they come from…This suspicion of loops just runs in our human grain, it would seem. However, as with many daring activities such as hang-gliding or parachute jumping, some of us are powerfully drawn to it, while others are frightened to death by the mere thought of it."

feedback. This may be due to its live temporal nature - as with any experimental or performative process, it presents challenges to exhibit or document. But it may also reflect a lack of technical literacy, a misunderstanding of how feedback works, or a general unease with video technology. Yvonne Spielmann (2006:62) suggests that theory has lacked an "electronic vocabulary" with which to articulate discussions of video as a medium:

> …a narrow perspective on the introduction of video technology fails to differentiate between applications that are specific (like feedback) and those nonspecific to video (e.g., the use of video for documentation).

Perhaps theorists struggled with the blurring of boundaries between artist and technician, as practitioners like Dan Sandin and Jean-Pierre Boyer began building their own video synths. Such a rejection was highlighted as far back as 1985 by Lucinda Furlong (1985:234):

> With the exception of Nam June Paik's well-known collaboration with Shuya Abe, the history of video art as it is presently constituted has virtually ignored the work of first-generation tool designers and builders.

This loss of signal has been met to some degree by Spielmann, above, and Meigh-Andrews, whose 'A History of Video Art' (2014) provides a detailed overview of video feedback and video synthesis practitioners, with interviews and photo documentation, even going so far as to include definitions within a glossary. Meanwhile, Artist Barbara Doser (2010) has also attempted to redress the balance through the lens of her own work an a feedback artist. She too suggests that 'art historians have failed to set down a record of video feedback's history' (2010:26). Though Doser stops short of analysing why this might be the case, her attempts to fill in the blanks are an important contribution to acknowledging this influential approach to making images.

1.5 Video in the Abyss - What Happened to Video Feedback?

Given that video feedback was so visually captivating and technically accessible for artists in the late 60s and 70s, we might wonder why it is so rarely used by artists today? Below I outline three possible explanations for its decline.

I. Artists fell too deeply in love with feedback

With its psychedelic patterns, feedback was hypnotic for audiences and artists alike, but these self-evolving forms didn't necessarily lead to an evolution of the artwork. Bill Gwin (1971:1) illustrates this trajectory with a note of caution:

> In the early days of discovery, feedback is magic: spirals, flowers, mandalas burst forth with the touch of a fingertip and regenerate themselves indefinitely on the screen. Later, for some, feedback's simplicity becomes deceptive and its ease occasions serious questions of composition… Its prettiness can be so enticing that time and energy are destroyed without leading to any serious expression or work. In this situation, it's been fun, but may be almost counterproductive to art.

II. The art world fell out of love with feedback

Perhaps, as America critic Robert Pincas-Witten suggested, these pioneers of video art technology were simply producing "bad art" (Meigh-Andrews 2014:134). However, Carol Goss (1996:2) suggests that this innovative art form was just in time to be too late, as wider tastes in art had already begun to change. For artists working with the 'painterly medium' of video feedback, the shift towards post modern and conceptual art in the 70s meant that it was over almost as soon as it had begun:

> Abstraction and "pure" art fell out of favor just as Analog Video Synthesis came onto the scene. The result was that the people working in this very painterly medium decided to do something else…museum installations or

documentaries for the most part.

III. Artists switched to digital

The most important factor wasn't the evolution of taste, but of technology. Put simply, something better came along. The arrival of computers gave video artists much more control over the form and animation of images, opening up a whole new world of possibilities.

> The specificity of digital meant we could have loss-less dubs and do field accurate postproduction. This was very difficult with analog. (Goss 2004:2)

The exponential increase in computing power has meant that digital is now more than capable of real-time rendering immersive 3D environments, complex particle physics and generative animations shaped by numerous interactive inputs such as camera tracking, sound, online data, and even brain activity. It would seem todays video artists have it all.

At the same time, we are left with the question of what 'video' is anymore. Meigh-Andrews (2014: 337) suggests the impact of digital technology (among other factors) has served to blur definitions of the medium, with the result that 'video's distinctive characteristics have been absorbed and merged into a wider, less definable and more complex set of related media'.

1.6 void loop() - The Digital Black Box

Sine waves and square waves

This thesis is not intended to set up an analogue vs digital dichotomy, but I would like to briefly consider what digital technology brought to a young and lively moving image format at the behest of problems with electro-magnetism, radio

frequencies and kinky cables. As Spielmann (2006:58) points out, there isn't such a clear distinction in any case - broadcast analogue video has always incorporated digital interfaces which would keep the signal in check[12].

> As early as 1973, video developed almost generic connections to algorithmic forms of the digital with the introduction of a digital clock and priority keys that enabled the video artist to control the modular waveforms of video.

Digital technology has utterly re-shaped art making practices - there has been 'a near-complete invasion of creative production by digital tools from the early 1990's onwards' (Watz, 2012). The rapid evolution of software tools and programming languages offers numerous approaches to developing generative, interactive and moving image works. Tools such as Processing, Houdini and Open Frameworks afford artists accurate control over discrete variables combined with endless flexibility. A complex artwork can be altered simply by changing a line of script, and changes are of course reversible (ctl+z), whilst the transferability of code allows work to be shared and repeated. Though digital tools are not without calibration issues - particularly interactive works, and especially those that utilise optical inputs - they provide an environment in which an artists can precisely manage the lower level mechanics responsible for producing the higher level image or experience[13].

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[12] Mark Bodner, technical manager at the North West Film Archive at Manchester Metropolitan University, describes digital as follows:

"It's discontinuous - in other words, it's a 'fait accomplis' - it's a set of cards, it's a fixed item, from the start of the capture, in its encoding, through the processing, all the way till we reach the display" (Meech, 2012: 3min 45)

[13] Hofstadter's (2007:42) descriptions of higher and lower level phenomenon provide a useful model for thinking about the different mechanics of generative art. Programming languages give the artist access to the lower level mechanics (the code) that generate the higher level experience (the image). Contrast this with optical feedback, in which the lower level mechanics responsible for generating the image are essentially photons! An artist can only control mid level interfaces - lenses, shutter speeds, etc - in response to the higher level phenomenon of images in real time.

Programming routines - reliably stepping in the same river twice

Digital is highly configurable, whilst being remarkably robust and repeatable. These are extremely important qualities for artists, as galleries and museums can require installations to function over many months, and many thousands of visitor interactions. Properly scripted, a live generative installation will run reliably for the duration of a show. Alternatively, the resulting animation can be 'baked'[14] or rendered as a fixed digital movie file that can be played back on a standard media player. Such was the case for Universal Everything's 'The Vehicle of Nature' (2019), a generative animation exploring fluid dynamics[15], shown at the Millennium Gallery in Sheffield, UK.

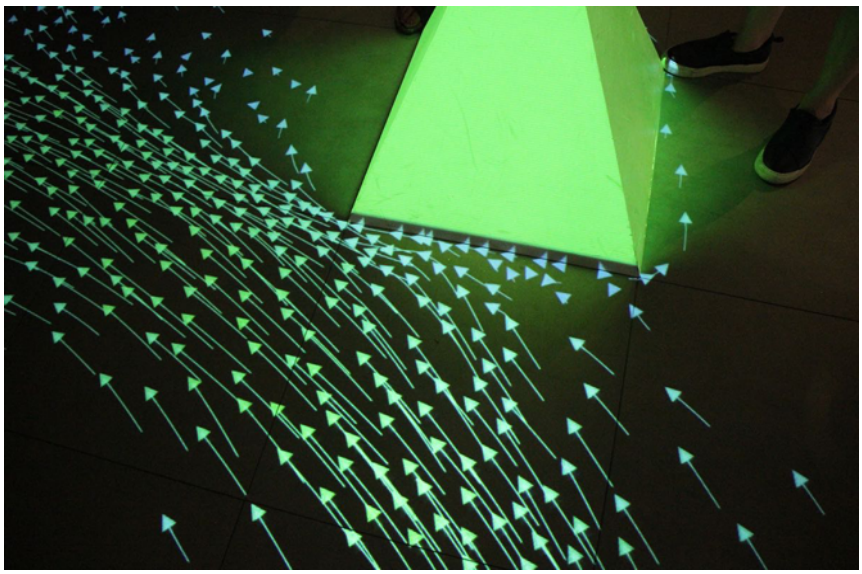

Figure 1.6.1 'Universal Everything - The Vehicle of Nature' (2019) - photo, Sam Meech

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[14] Baking is term used within 3D graphics to refer to the process of render mapping - fixing the appearance of light and texture onto surfaces. By fixing geometric data as an image format, flexibility is traded for performance. (https://en.wikipedia.org/wiki/Texture_mapping#Baking)

[15] Watz (2012) suggests that natural phenomena and emergent complexity are a recurrent motif within generative art:

"Inspiration taken from processes found in nature is common, with the tension between organic and mechanical forms ever-present. A common challenge in computational aesthetics is the simulation of organic behaviour and spontaneous irregularities, phenomena that appear in nature without prompting but which can only be replicated by computers with the explicit encoding of such behavior." (Watz, 2012)

Developed in the 3D animation software Houdini, 'The Vehicle of Nature' projects various particles (water droplets, arrows, blood cells, and even people) so they appear to flow around static objects on the gallery floor. The precise mapping creates a compelling illusion - a mesmerising blend of the real and the virtual. Thanks to the reliability of digital, this 'river' streams perpetually, untroubled by audiences as they step into the projected light or by changes in the environment. Even if this had been a 'live' generative installation, rather than a 'baked' animation, it would only be affected by interaction if it had been expressly programmed to do so. We could even argue that the river would still run even if the projectors were turned off. Unlike real water, these waves would also halt if we commanded them.

Never stepping in the same river once

That is not to say digital is without drawbacks - each technology brings its own unique set of snags. The decision to present The Vehicle of Nature as a fixed, rendered animation was likely a pragmatic compromise to reduce the potential for problems and downtime. But compare the example above to an optical video feedback projection, generating similarly fluid patterns on a gallery floor. As will become clearer in later chapters, such an installation would be susceptible to small changes in ambient light, never mind the interactions of visitors in the projected light, or (god forbid) even slightest nudge of the camera. It certainly could not be paused. In the context of exhibition, 'The Vehicle of Nature' is an illusion - convincing, captivating, but a simulation of a phenomenon rather than an actual phenomenon. To draw another analogy from nature, we could regard a digital installation as an electric fireplace - a faux fire; the flames look real and it feels warm, but it can be turned on an off at the flick of a switch. Video feedback has no 'off' switch - like a real fire, it must be lit each time, and carefully protected lest it

go out[16].

Video Feedback relies on carefully balanced relationships of apparatus that borders on the theatrical. The arrangement of equipment constructs the mechanics - the 'code' - that generates the image. The hardware is the software! But since these are physical objects, arranged in real space, they are unavoidably apparent to audiences, who are encouraged to adopt a more reflexive mode of viewing. For video feedback installations, the 'work' is both the image and the architecture. This places it closer to the realm of Expanded Cinema, with its foregrounding of space, technology, process and performance. In contrast, the mechanics of digital artworks are usually 'hidden from sensory perception in the black box of computational processes' (Hoy, 2010:1). The software that creates or controls a generative or interactive work isn't normally displayed for an audience, and we are not encouraged to unpick the architecture. As Marius Watz (2006) describes:

> Code is pragmatically accepted as an optimal material for the investigation of systems and structure, but is often omitted from the final presentation. Due to its symbolic value as a techno-fetishistic object, code becomes a distraction rather than an aid to the appreciation of the work. The work is created from code, but is not about code.

Similarly, where possible, the equipment also tends to be hidden, with computers,

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[16] Fire is a recurring image for artists speaking of working with feedback. Woody Vasulka uses the motif when describing his own initial encounter:

"When I first saw video feedback, I knew I had seen the cave fire. It had nothing to do with anything, just a perpetuation of some kind of energy" (Gill, 1976:46)

The notion of energy or entropy is a useful way to understand the behaviour of feedback. In a similar way, theoretical physicist Carlo Rovelli (2019) also uses the image of fire to describe entropic growth in living organisms.

"There is a common idea that a living organism is a sort of fight against entropy: it keeps entropy locally low. I think that this common idea is wrong and misleading. Rather, a living organism is a place where entropy grows particularly fast, like a burning fire. Life is a channel for entropy to grow, not a way to keep it low."

cameras, network ports, etc either encased behind walls or cloaked in the darkness of the gallery rafters. In contrasting early video artists such as Dan Graham, with contemporary media artists like Rafael Lozano-Hemmer, Christine Ross (2011:185) suggests there has been a 'projective shift' from an 'aesthetics of self-criticality, distanciation, and reality-versus-illusion' to an 'aesthetics of immersiveness, relationally, and real-virtual continuum'. As audiences, we don't know what is actually going on behind the curtain, we are just encouraged to experience the effects[17].

In summary - digital tools have opened up the possibilities of creative production, providing an unparalleled level of control and precision, helping to make works that are robust and repeatable. At the same time, it could be argued that digital installations lack the unpredictable vitality, or the open self-reflexivity of early video art practices. Could the fire of video feedback be fed back into media arts? Could digital tools once again be used to tame the analogue video signal? In the next chapter I will look at a number of artists who are reconnecting with feedback to create hybrid works from a contemporary perspective.

[17] A playful exception to this approach would be Algorave (https://algorave.com) an open community co-founded by Alex McLean that promotes improvised live coding audiovisual performances. Though the focus of Algorave events is firmly on 'humans making and dancing to music', the code that generates the sound and images is written and displayed to the audience in realtime, alongside (or over) the resulting visuals.

the signal is lost

digital videos are

waves as binary

Chapter 2

Feeding Forward - Contemporary Practitioners and Approaches

2.1 Re-connecting the Loop

In her essay 'Video Feedback - Lyricism in Patterns of Light', Barbara Doser (2010:30) asserts that 'present day video feedback technology is employed in the work of solely a few artists'. So, has the loop unravelled? Hopefully not. Whilst there is some truth to Doser's argument, I think there are indications that feedback practice is not only alive, but evolving in interesting ways. In this chapter I will highlight examples of video feedback practice by artists today, and in doing so, begin to outline some general themes. However, these territories of feedback practice are not discrete categories but interchangeable lenses. The artists and works surveyed often share a number of approaches and aesthetics.

2.2 Pattern Generation and Emergence

Let's start with Barbara Doser herself, an Austrian artist based in Vienna, who utilises optical feedback as a pattern generator to develop films, paintings and sculptures. Since 1993 her technical setup has comprised a video camera (Hi8, later mini DV), CRT monitor, and image processor. Doser employs optical feedback as the sole source of imagery, ensuring her work 'maintains the original abstraction' (2010:30). Films such as 'even odd even' (2004, Figure 2.2.1) and 'someone's blood' (2017), illustrate this fascination with emergent forms in flux. Doser dissects the feedback both spatially and temporally in order to create new layers of repetition and symmetry.

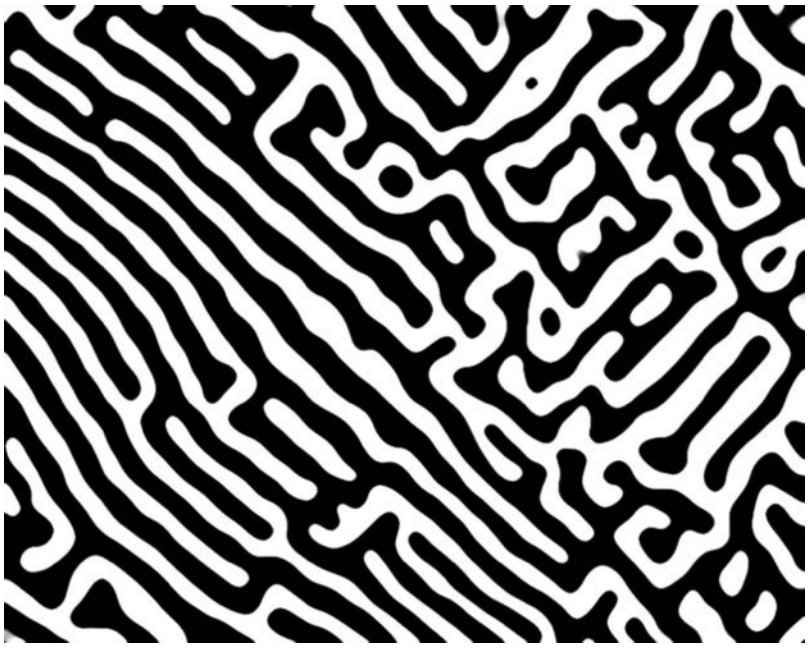


Figure 2.2.1 - 'even odd even' (Barbara Doser, 2004)

A preoccupation with emergent patterns is shared by Ethan Turpin, a video artist and designer based in Santa Barbara, California. Turpin creates installations that convey a fascination with natural forms as well as drawing attention to the fragility of ecosystems. His interactive projection works such as 'Video Organisms' (2017) and 'Video Feedbackteria' (2010) are carefully balanced ecologies of cellular automata designed to create not only an engaging sensory phenomena, but to provoke a critical awareness of our own impact on the work, and by extension, the environment.

A similar aesthetic can be found in the work of Marc Fichou (born in France, based in Los Angeles), though Fichou is less concerned with ecology or interactivity, than with notions of authorship. He argues that 'we can't say it [feedback] is creating because it has no conscience. So it's not an act of creating, it's only the act of emergence' (Lindstrom, 2014).

Figure 2.2.2 - 'The Artist' (Marc Fichou, 2014)

For his show 'Ouroboros' (2014) Fichou created a 'video feedback machine' called 'The Artist'– a minimal installation comprising a video camera tilted and pointed at an LCD monitor, that together produces complex emergent patterns.

> Without a referent in the world, they don't copy anything, though they derive only from the process of their own reduplication. Nor do they stand as original artifacts, though they are unpredictable and unrepeatable. They suggest purely virtual self-organizing events without depth, substance, or "filiation". (Mattessich, 2016)

Fichou places this device inside a glass and aluminium structure, shaped like a small coffin, to protect the delicate system from outside interference. This life-support machine maintains laboratory conditions whilst the patterns emerge in a constant - potentially infinite - expression of self-renewal. The title of the work, 'The Artist', is an ironic concession of authorship to greater forces. For Fichou, there is no 'creator'. God is dead, and so is the artist.

2.3 Infinite Interfaces

The technique of placing a picture within a picture, or mise-en-abyme, forgoes the abstraction of pattern generation, instead allowing us to recognise repeated forms in a multi-dimensional space. The approach creates a perceptual paradox that folds the space, the equipment and audience presence into works that reference the infinite.

Figure 2.3.1 - 'A Place Like This' (Timur Si Quin, 2016)

In his works 'A Reflected Landscape' (2016), 'A Place Like This' (2016, Figure 2.3.1) and Mirrorscape (2016), Berlin-based artist Timur Si Quin uses mise-en-abyme to address the notion of planetary consciousness. In these works, Si Quin places a live camera and LED display within an installation of real and artificial flora, rocks and sand. The screen displays a live image of itself set within the landscape, creating 'a post-anthropocentric diorama in which nature has gained the capacity for self-understanding'. (Si Quin, 2016)

Daniel Iregui, a Columbian-Quebecois digital artist based in Montreal, fuses

geometry and recursion to make interactive works that seem to frame infinity. OMNIPRESENCE (2017, Figure 2.3.2) places the audience themselves within a mise-en-abyme in order to create a sense of 'multiple realities'. The piece combines simple optical feedback mechanics with digital manipulation to create a playful visual echo chamber. The audience enters in front of a large screen (4m square), whilst behind them, a camera captures both the screen and the user. Before the camera feed is sent back to the screen, however, it is mediated by digital software (Touch Designer[18]) in order to introduce a series of simple spatial and temporal changes; flips on the x and y axis, video delays, and even the ability to store footage in the memory and play it back at a later point, in reverse, or with randomised frames.

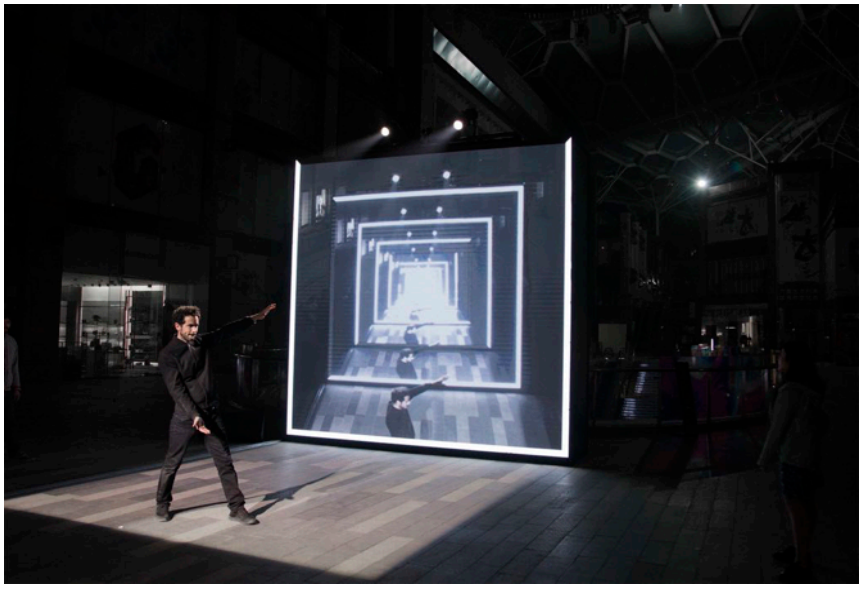


Figure 2.3.2 - 'Omnipresence' Xian, China (Daniel Iregui, 2017)

Though audiences can generally decode the broader technical setup, Iregui's

[18] Touch Designer is a software by Derivative, Toronto, CA. Combining node-based and scripting interfaces, the tool has become popular with artists working with generative video and interaction design. Touch Designer can even be used to create internal video feedback - looping the digital video processing workflow to generate patterns and textures that exist natively to the software.

intention is to go beyond a simple reflexive environment, in order to elicit a form of 'expressive interaction' As their movements ripple down the loop, users begin to exploit these mechanics through their own choreographies.

2.4 Hybrid Materiality and Sensitive Bodies

Guillaume Vallée is an experimental film-maker, video artist and curator, based in Montreal, Canada. Vallée applies a recursive, cross-media methodology to create hybrid feedback forms with remarkable textures. For his film, 'What is Beyond the Hellraiser?' (2017, Figure 2.4.1), Vallée reused a 2 second paint-on-film (camera-less) loop, which was then transferred to DVD and digitally projected on a rear projection screen. A second projector and VHS video camera were used to create a feedback loop over the top. This composite image was re-shot from the other side of the screen using a super 8 camera and Kodak Ektachrome film. The resulting film is an intense 2 minutes and 38 seconds of sonic and chromatic oscillation. An unrelenting electronic soundtrack straps us to the rippling inhale and exhale of coloured smoke - a respiration coaxed through careful manipulation of the zoom of the video camera in the feedback system.

The recapture of feedback onto film recalls the Doctor Who titles (chapter 1), and the work of Becker (Horizon[19], 1967). The technique makes the medium difficult to pin down - we can deduce from the scratches and emulsion that it exists materially at some level as celluloid, but the movement is evolving and complex

[19] Ben Palmer (co-creator of the Doctor Who titles) went on to collaborate with Lutz Becker, who had begun experimenting with feedback techniques in 1965. Together they produced three films, including 'Horizon' (1967), which was broadcast by the BBC as part of it's programme 'Horizon: Will Art Last?'(1967). Described by Gene Youngblood (1970:366) as a form of 'concrete motion graphics', *Horizon* focuses purely on the emergent patterns within feedback. The forms were captured on 35mm black and white film, before being colourised with an optical printer. Becker's ambition was to 'create some kind of visual equivalent to electronic music' (Jennings 2015:9).

in a manner consistent with video feedback. There is both chemistry and physics at play. We are not watching a film, but a force.

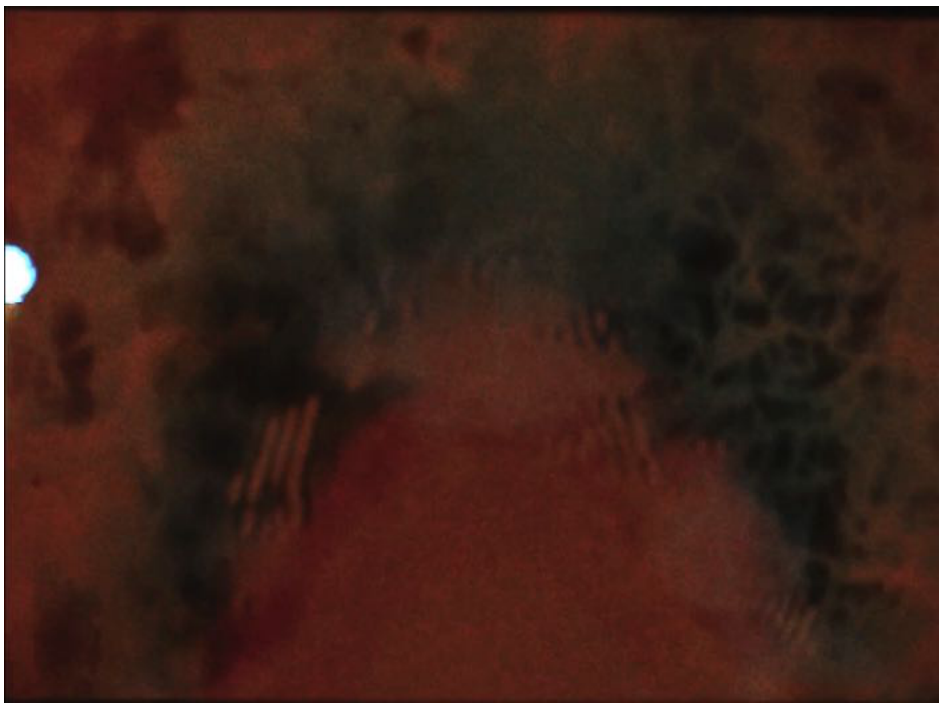


Figure 2.4.1 - 'What is beyond the Hellraiser?' (Guillaume Vallée, 2017)

The concepts of force and energy suggest a vitality within feedback that lends itself to performance. Vallée collaborates on live feedback performances with Sonya Stefan, a media artist, curator and co-founder of La Lumiere Collective. Stefan describes her practice as a 'hybrid' - incorporating dance, film, video art, AV performance and installation. She regards feedback as a performative practice, much like dance - existing in the moment, shaped by space, requiring a sensitivity to respond. But she also regards it as an entity with its own agency that she works with and reacts to. In our interview, Stefan discussed this compelling notion of the materiality of video feedback:

> I say it's uncontrolled but it's not uncontrolled. It's basically understanding information through a sensitive body and reacting towards that

information through a sensitive body.

Stefan's account of working with feedback as a 'sensitive body' resonates with video artist Carol Goss's (1998:2) observation that 'it was never a solo venture though. One was always aware that one was collaborating with the raw force of electricity'.

Figure 2.4.2 - 'performance, Sight and Sound, Montreal' (Sonya Stefan and Guillaume Vallée, 2016)

2.5 Video Synthesis and Glitch Analogique

Technologically driven yet performative, analogue video synthesis requires a close interrogation of (and sometimes significant investment in) the hardware; exploiting the electronic peculiarities of the equipment in order to generate rich textures and patterns. Whilst optical video feedback can be incorporated, the emphasis tends to be on exploring internal feedback systems. The practice today owes much to the work and spirit of early electronic pioneers who built their own tools to generate and manipulate the video signal.

The video synth scene - closely aligned with electronic music, modular synthesis and the online glitch art community - has grown hugely in the last decade. This is partly down to the growing number of technological options available to artists today. New high-end commercial tools like the LZX Industries range of modular video synths exist alongside (relatively affordable) second-hand hardware - 'obsolete' analogue video mixers like the Panasonic WJ-AVE5. Meanwhile, the hands-on pioneering spirit lives on in lo-fi approaches like circuit bending and custom-built electronic modules. There is also an increasing visibility of analogue video practices, thanks to Instagram, and online communities sharing knowledge, such as the Video Circuits group on Facebook, created in 2013 by Chris King and Christopher Konopka.

Rob Feulner (Montreal, CA) and Paloma Kop (New York, US) are co-organisers of TÉLÉPRESENCE - an annual meet up of video synthesis and analogue glitch artists taking place in both cities, that formed around the Video Circuits group. The event is a real-world, real-time schematic, as practitioners gather to share work and methodologies through performance and table top demonstrations. Though we can draw a parallel here with the sharing of source code in digital arts, as Feulner points out in our interview, for video synthesis 'there's no patch that you can just load and it's all there. You have to rebuild it every single time'. He patiently records his own setups by drawing simple schematics in a Photoshop template (see Figure 2.5.1). However, given the many variables involved, he is realistic about the limitations of this approach when it comes to the repeatability of feedback experiments:

> At the very least I'm within the ball park. And if you give me another 20 minutes, I'll hopefully get it. And then other times it's just like "well that's just lost forever". Because who knows, maybe one of the RCA cables was

half broken and that's why it was giving me that effect.

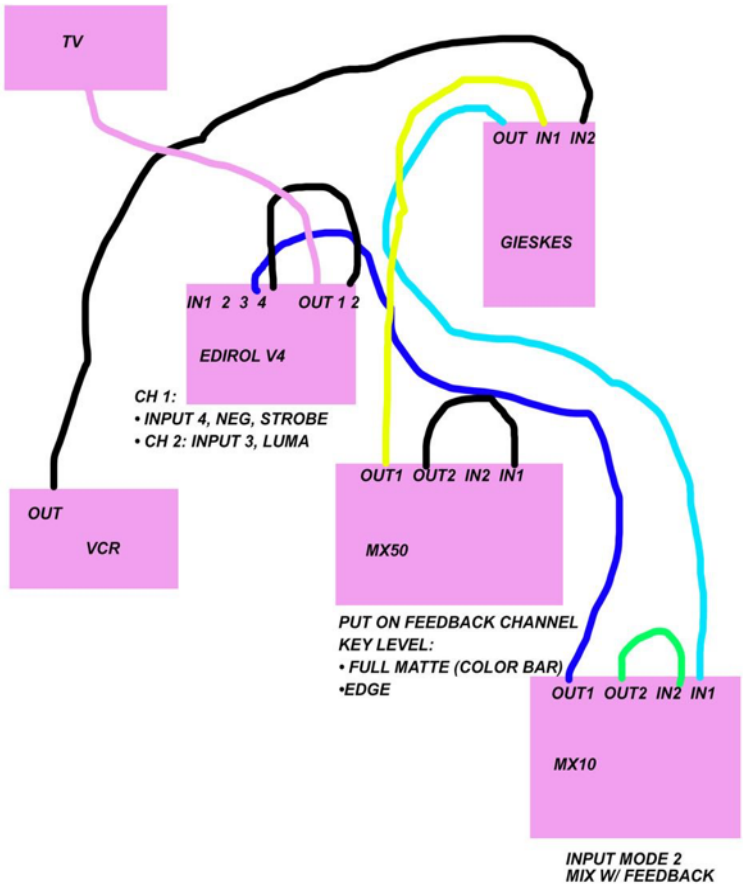


Figure 2.5.1 - Japanese Firework schematic,(Rob Feulner, 2019)

Feulner's films combine figurative elements with feedback textures to suggest a narrative space or mood. 'Video Art for Conditional Malaise' (2017, Figure 2.5.2) carefully layers time-lapse footage of flowers blooming through the use of luminance key effects, before folding internal feedback textures between the petals. Designed as a meditative tonic for the long Canadian winter, and the gloom of the 2016 US election, 'Video Art for Conditional Malaise' hints at the possible therapeutic properties of feedback and video synthesis. Such qualities were also suggested by artist Carol Goss (1996:1), whilst working with video synthesis and feedback at the Experimental Television Centre in the 1970s,

describing the process as ‘so hallucenogenic and mesmerizing, that it naturally led to higher levels of observation’.

Figure 2.5.2 - ’Video Art For Conditional Malaise’ (Rob Feulner, 2017)

A darker form of cognitive sedation is playfully explored by Paloma Kop (working alongside Bobby Pharaoh) as ‘The Bureau of Fugitive Dream Recovery’ (2019) - a series of hypnotic audio-visual experiments framed within a conspiracy theory. Released on VHS cassette through Feulner’s ‘Bleu Nuit Video’ label, the videos demonstrate an array of techniques including optical feedback, internal feedback, oscilloscopes, chroma-keying and text generation. As with Kop’s AV performance work, we are presented with diverse textures and feedback forms that reflect her interest in chaotic systems, iteration and emergence.

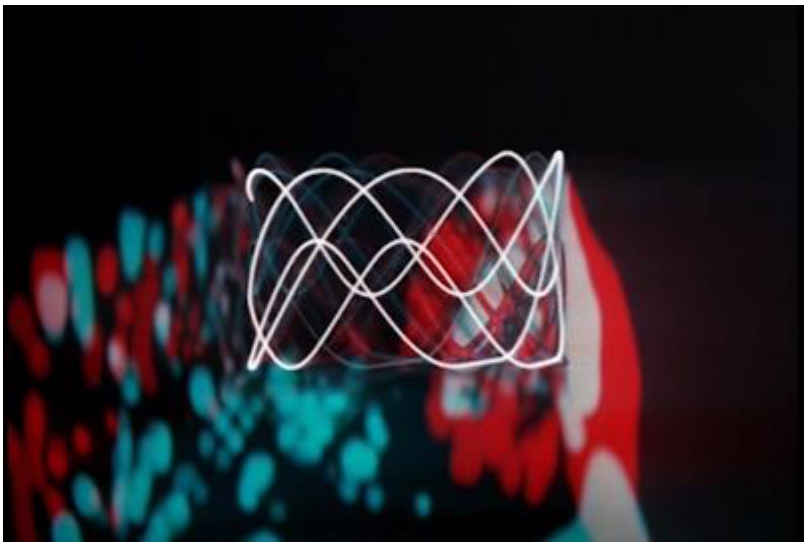


Figure 2.5.3 - 'The Bureau of Fugitive Dream Recovery' (Paloma Kop and Bobby Pharaoh, 2019)

2.6 Systems Aesthetics

The foregrounding of technical components encourages us think about the systems themselves, in relation to the space and the audience. These works carry on the self-reflexive surveillance work of Dan Graham and Bruce Nauman, but often provoke as to consider the shift from analogue to digital.

Figure 2.6.1 - 'Innervisions' (Colby Richardson, 2018)

For Innervisions (2018, Figure 2.6.1), media artist Colby Richardson (Winnipeg, CA), creates an ongoing series of reflexive installations using old televisions to display the live feed from a VHF transmitter. The transmitter is linked to a video camera in the gallery space, presented as a sculptural object alongside the television. The camera is pointed at the television screen, resulting in a recursive repetition of the image that contrasts the notion of the infinite with the obsolescence of the CRT television as a broadcast receiver. Through this loopy arrangement, Richardson is drawing our attention to the latent mechanics of VHF, and also its redundancy as a technology beyond the boundaries of the work.

Louise Robson, a digital artist based in Wigan, UK, develops systems artworks that respond to the viewer and the environment. 'Feedback Camera' (2014, Figure 2.6.2) uses a webcam, projector and Processing software, to automatically capture and re-present still images from the gallery space every 10 seconds in a steadily updating mise-en-abyme. Gallery visitors are implicated into this temporally staggered[20] feedback loop, and so can respond by re-positioning themselves to perform a stop-motion choreography.

A key difference from other feedback works is that the projection in *Feedback Camera* does not display a realtime video signal but digital images captured and recalled from a database. For Robson, the 'artwork' is not made of the physical components, but from the concept, code and contract. In 2016, Robson sold the work (a Processing software patch, installation instructions, and permission to

[20] This procedural staggering of the capture and representation recalls the expanded cinema performance screenings of William Raban's 2'45" (1972), later recreated as 4'22" (2008). Starting by filming a blank cinema screen on 16mm black and white stock, Raban developed the film before projecting the result at a subsequent screening, whilst re-filming the screen at the same time. Over a series of events, Raban simultaneously projected and captured each iteration of the film, discarding the projected reel in favour of the newly recorded image. Raban (2011: 102) refers to 2'45" as 'a film that begins and ends with the period of its making…a film which IS its showing'.

present it) to the University of Huddersfield, thereby implicating the institution into the larger web of elements that 'constitute the artwork and the system it participates in' (Robson, 2016).

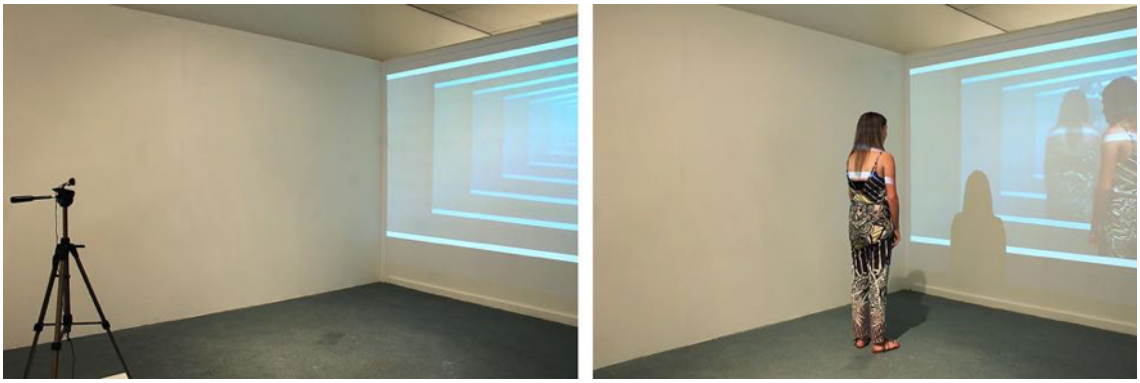


Figure 2.6.2 - 'Feedback Camera' (Louise Robson, 2014)

2.8 Summary

The artists and approaches discussed in this chapter do not represent a comprehensive overview of video feedback practice - one day we might hope to collect and classify every species of 'feedback form' - but hopefully they start to map some analogue terrain amidst the increasingly digital media arts landscape. Video feedback is being used to generate patterns, to construct infinite realities and interactive installations, to merge moving image mediums, create reflexive environments and complex systems, as a collaborative 'body', as a performative instrument, and as a signpost to scientific theory. We could argue that many of these techniques have digital software counterparts (or 'analogues'[21], if you'll pardon the term) - so what makes video feedback different? Why use it at all?

[21] The term 'analogue' is etymologically linked to analogy (sharing a root in a Greek adjective meaning *proportionate)*. Digital is ironically, always an analogy - a discrete data model, for a real-world phenomenon. Thus, digital *is* analogue!

In the next chapter I will outline my own practical experiments with video feedback whilst drawing upon these themes. I'll identify some new practical approaches to incorporating optical feedback into digital systems, highlighting both the creative possibilities and technical concerns. As will become evident, my own experiments with feedback incorporate aspects from each theme, but with a strong emphasis on emergent patterns and the use of video feedback as an interactive interface.

camera and screen

a snake eating its own tail

output to input

Chapter 3

Video Voyages

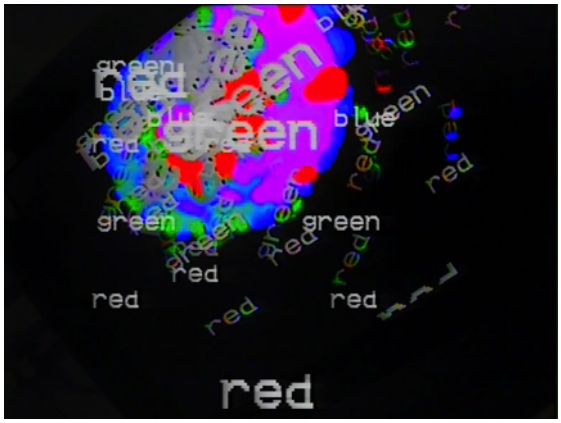
3.1 Hofstadter's Voyage

One day in 1979, Professor Douglas Hofstadter went searching for strange loops. Hofstadter was on a 'video voyage' - playing with a video camera mounted on a tripod, and pointed at a television - when he witnessed the appearance of a 'strange long corridor' of screens (1979:484). Adjusting the rotation and zoom of the camera inspired new forms to emerge from this 'self-engulfing' television; galaxies, black holes, and pulsating petals. Hofstadter began to wonder if consciousness wasn't also like a camera pointed at its own screen.

Hofstadter's experiments with feedback are first expressed in his Pulitzer Prize-winning book - *Gödel, Escher, Bach: An Eternal Golden Braid* (1979:43) as a philosophical dialogue between two characters, Achilles and a Crab. Whilst the manner of recounting may be unusual, the dialogue identifies how key technical variables - the angle and zoom of the camera, the latency of the video circuit - play a key role in the creation of feedback forms.

My own Video Voyages allowed me to explore the impact of these variables, and more broadly, the effect that different types and models of video equipment had on the feedback. I tested a variety of cameras (video cameras, cctv, webcams), displays (CRT, digital LCD, projection), and video mixers, in an attempt to get a feel for working with the phenomenon as an artist. I combined these with digital video processing tools (Isadora's chroma keying and projection mapping modules, Camtwist's screen capture capabilities) in order to assess the potential of a hybrid approach using analogue hardware and digital software.

3.2 Postcards from my Voyages



2018-10-05

'RGB'

Scrolling white text generates colours as the camera's white balance adjusts.

2018-10-05

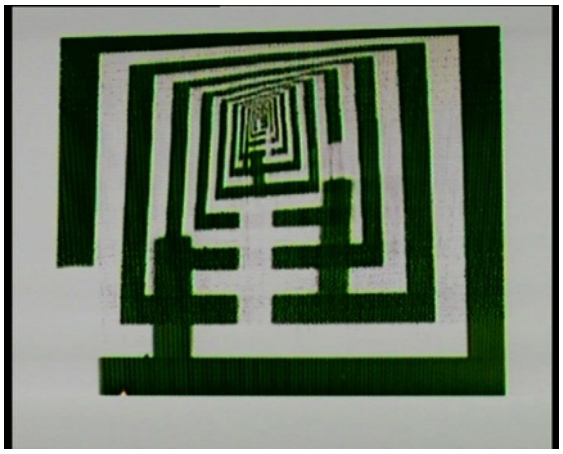
'RGB' - setup

HD cctv camera > composite video out > 3 daily chained analogue video titlers > HD LCD television

2018-11-16

'Quad Door' -

Two small cctv cameras plugged into a quad splitter, and into a small colour LCD monitor



2018-11-17

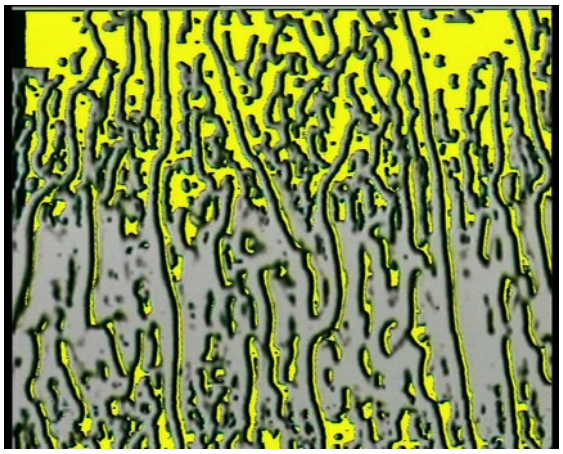
'Nega Doc Mix' -

Using the 'negative' effect and low saturation on the Panasonic WJMX12 video mixer, combined with the input from a document viewer

2018-11-17

'Nega Doc Mix' -

Patterns start to emerge as we rotate and zoom towards the screen



2018-11-17

Nega Doc Mix' -

Introducing colour keying effects changes the patterns

2018-11-19

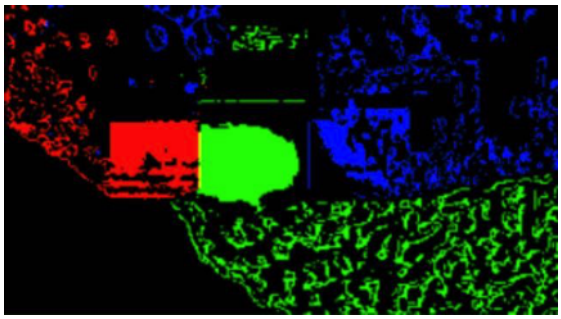
'Izzy syphon'

Using syphon within isadora to link two projection mapping actors.

2018-11-19

'Izzy syphon'

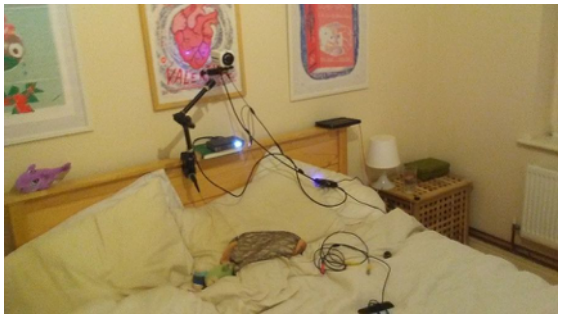
This recreates the earlier analogue 'negative' experiments but with wholly digital effects including rotation.



2018-11-19

'Izzy syphon'

Combining projection mapping with 3 separate chroma key channels creates competing colour systems



2018-11-26

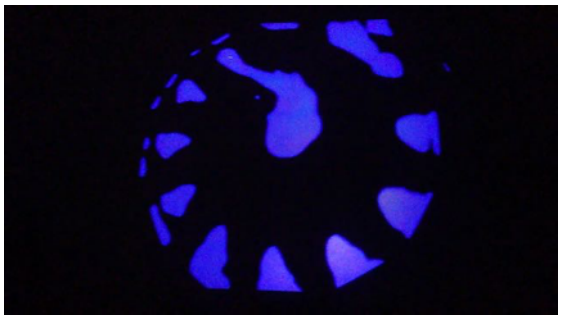
'bed'

An interactive night light - feedback can happen in any space.

2018-11-26

'bed'

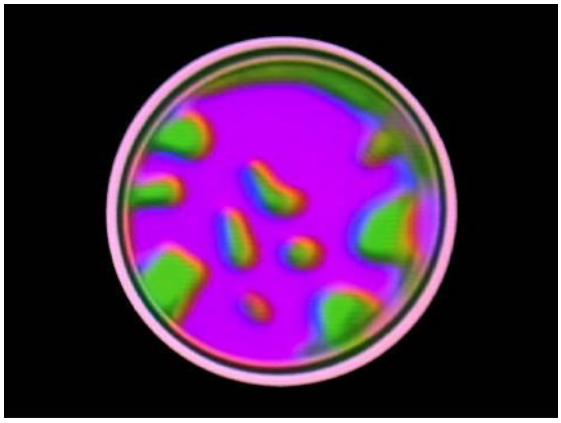
Placing my leg in a rotating ball of feedback, I begin to break it up



2018-11-26

'bed'

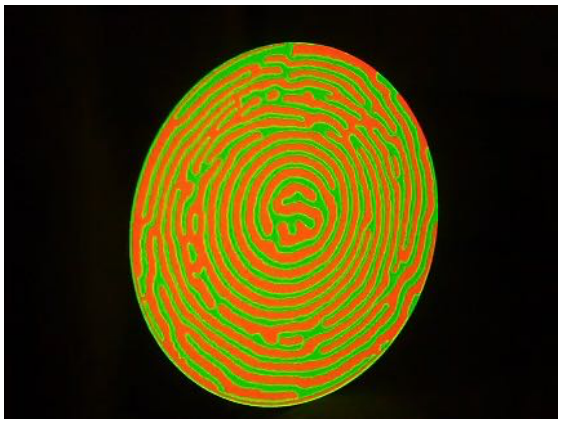
The projection continues to spin, but with many separate 'islands'. Eventually it will reinforce itself and grow back.



2018-12-02

'Petit Portal'

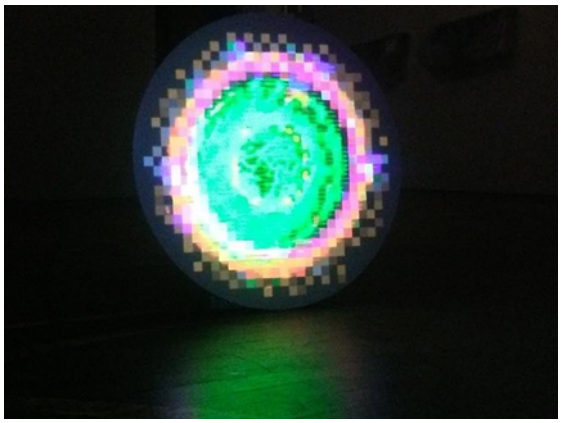
Projection mapped circle using Isadora and DV cam. Rotational effects plus HSL shift creating some alien blobby patterns



2018-12-02

'Petit Portal'

Inverted threshold (red / yellow) generates amazing 'Turing' patterns



2018-12-02

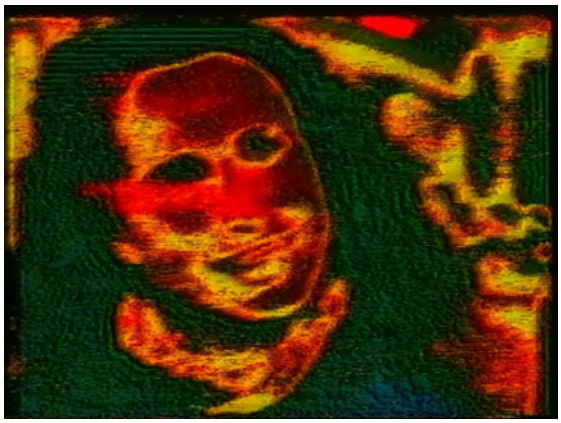
'Petit Portal'

Here I use Isadora to introduce dithering effects, playing with 16 bit colour depth and low resolution output

2019-02-02

'Groundhog Day Remix'

Analogue remix from VHS tape using internal feedback from 2 x video mixers, plus an optical input



2019-02-02

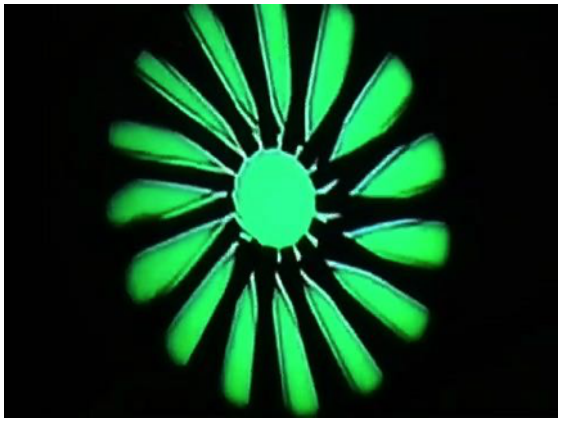
'Groundhog Day Remix'

Working with Raz Ullah, we remixed the film 3 times in a row, streamed live to Twitch.tv

2019-02-02

'Groundhog Day Remix'

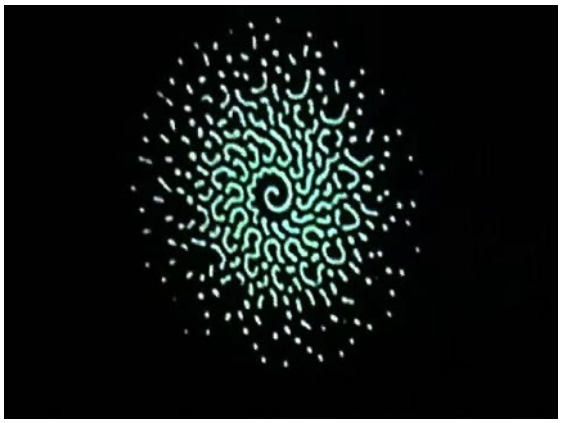
The living room became a TV studio - note camera in foreground, right



2019-02-03

'iMac Turing'

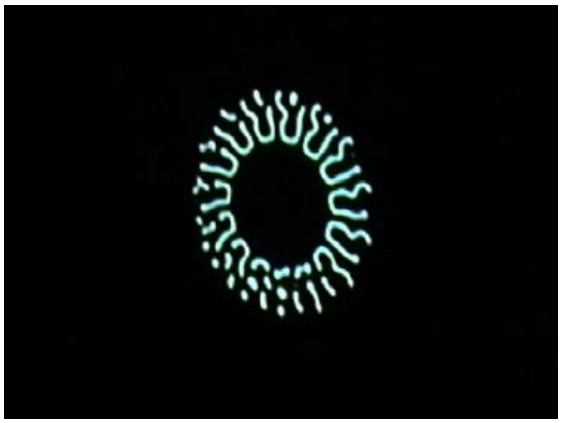
DV cam > iMac display (no effects software). A jade ball is carved into spoke by a pen



2019-02-03

'iMac Turing'

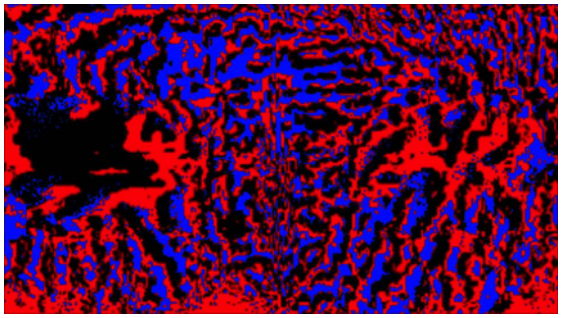
The image breaks down to a delicate balance of worm-like forms mutating, growing and receding



2019-02-03

'iMac Turing'

'Carving' more away until the rotating form is just a ring that is barely clinging on to life.

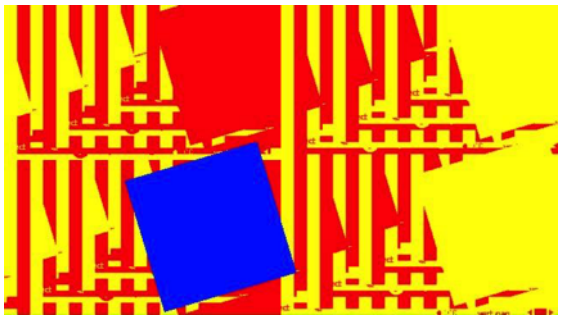


2018-11-20

'Izzy Red vs Blue'

DV camera > Laptop > HD tv

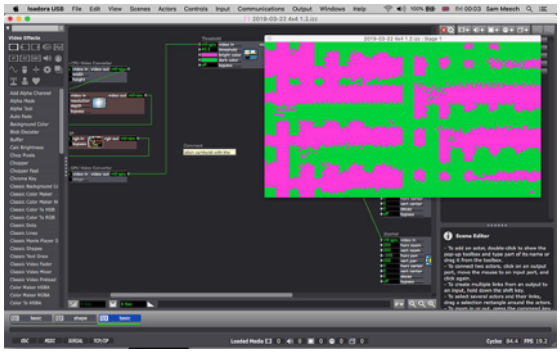
Isadora mapping with red and blue video delays creates volatile textures



2019-03-22

'Izzy 4x4 camtwist'

Camtwist screen capture software[22] *and isadora - shifting the window creates very clean echoes on the xy axis*



2019-03-22

'Izzy 4x4 camtwist'

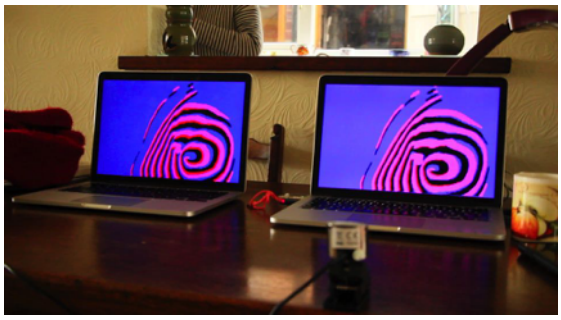
Introducing dither forces Isadora to reinterpret the image in lower resolution

[22] Camtwist Studio (http://camtwiststudio.com) is a free screen capture and video-routing software for mac. It enables users to easily select areas of the screen to send as video feeds to other software, or to create virtual 'cameras'.

2019-03-23

'Twins'

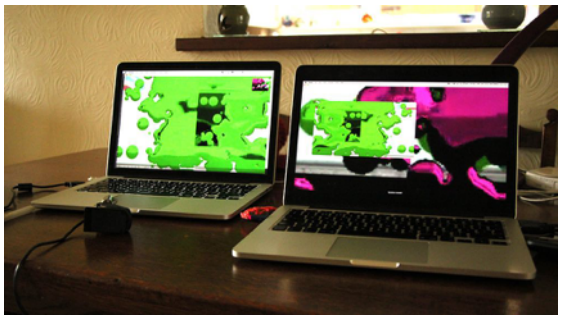
Two laptops swap webcams, projection mapped with Isadora. Red and yellow zebra stripes from threshold inversion.



2019-03-23

'Twins'

Shifting through a series of video effects generates strange whorls, the images they create are tied together.



2019-03-23

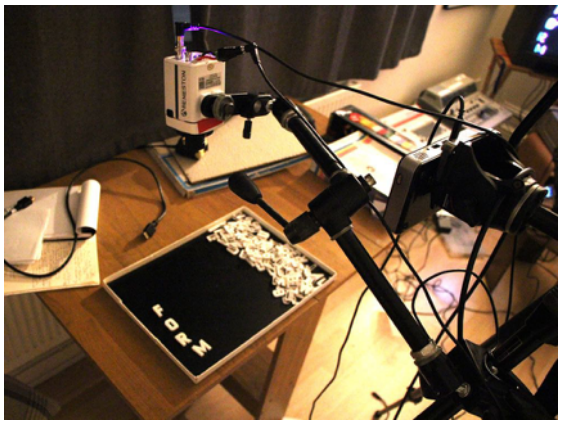
'Twins'

Switching to Skype video streaming and screen capture via Camtwist - no cables and no optics and yet we get alien slime!

2019-03-31

'Form'

Magnetic letters on a blackboard are used as a mask for an optical feedback system, with video mixer effects colouring the mask



2019-03-31

'Form'

One camera points at the letters, creating an optical interface that we can interact with, changing the mask

2019-03-31

'Form'

Adding rotation to the feedback camera, creates new forms from 'form'!

2019-05-31

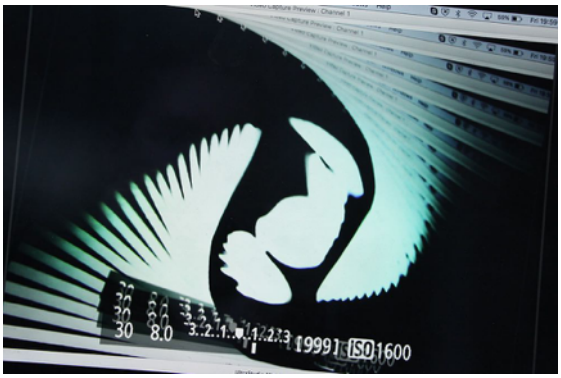
'Abyme Laptop'

DSLR Canon 60D, HDMI out > laptop via Blackmagic intensity shuttle - a very clean, crisp infinite corridor

2019-05-31

'Abyme Laptop'

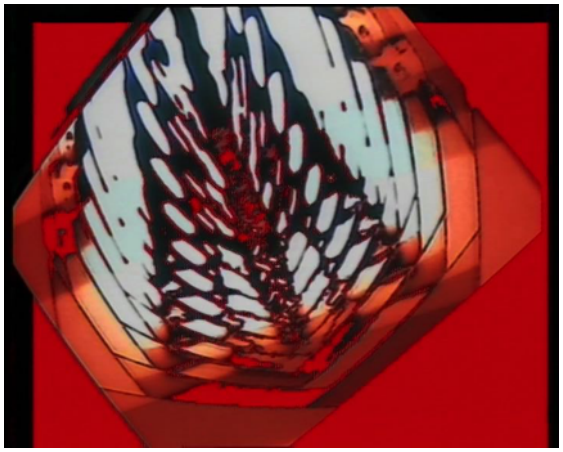
The edges of the screen create interesting shapes, and the ever so slight vignetting adds a sense of depth



2019-05-31

'Abyme Laptop'

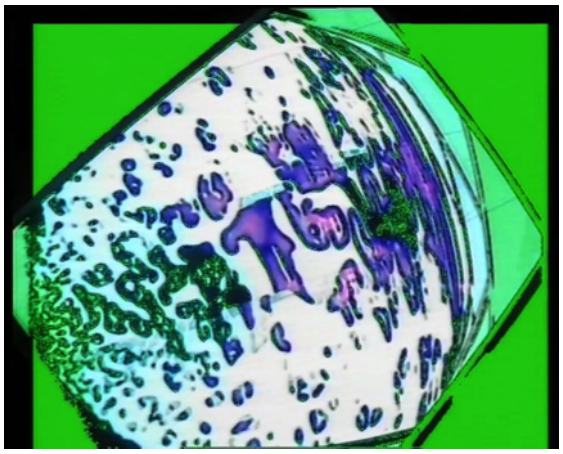
Zooming in, pushing the onscreen elements into abstraction



2019-05-31

'Alien Leaf'

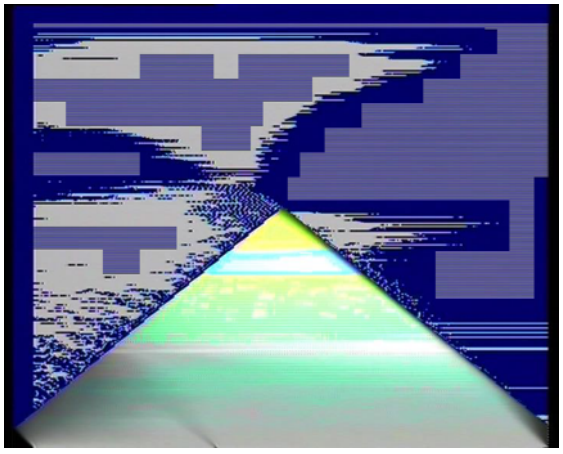
Video mixer, video camera and CRT television



2019-05-31

'Analogue Alien Leaf'

Chroma keying effects generating extremely organic textures.



2019-06-22

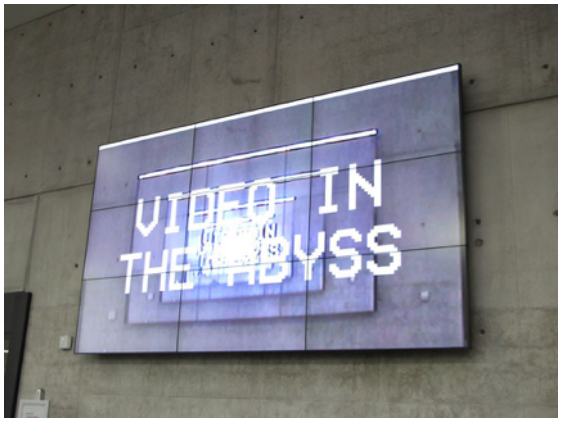
'Analogue Pyramid Glitch'

Video mixers and shape wipe transitions combine with internal feedback and mosaic effects to create a mixture of textures.

2019-10-01

'Big Screen Abyme'

Taking advantage of the large HDTV matrix, analogue Hi8 video camera, laptop, streaming to twitch.tv = huge latency!



2019-10-01

'Big Screen Abyme'

Adding some text into the mix via Isadora, whilst folding the concrete backdrop into the image

2019-10-01

'Big Screen Abyme'

Threshold inversion generating the zebra stripes, mapped with Isadora

3.3 Observations

I made a number of recordings, reflections and schematic drawings during my video voyages. Rather than deconstruct each voyage in detail, I have outlined some general observations drawn from these open-ended experiments.

Cable Spaghetti

Optical feedback is a messy business with a sprawling physical footprint. My living room became overrun with lengths of composite video cable snaking back and forth between camera, monitor and video mixer.

Wireless Networks

Tools such as Skype and Twitch.TV could provide an interesting alternative to a cable heavy setup. Though it introduces a significant latency in the loop, video streaming frees up the system from some of the restrictions of space, whilst opening up the feedback patterns to remote audiences.

Reliably Unpredictable

Whenever I pointed a camera at a screen, I was never really sure what (if anything) was going to happen. I could have a rough guess, but I couldn't say for sure. This sense of surprise was both frustrating and exciting. I had to accept that I didn't really know what I was doing!

Too Many Variables

Every small detail seemed to greatly affect the feedback - ambient light, the contrast and brightness of the screen, the diffusive properties of a projection surface, the camera model, camera lens, white balance, exposure.

Context

Given the impact of ambient light and space, the environment often becomes part of the system. Projection mapping may exploit that opportunity, using the context to inform the behaviour of the feedback.

(Un)repeatability

When something exciting did emerge, it was almost impossible to repeat it a second time. Even with the same camera settings, there was no guarantee the feedback would behave in the same way.

Performativity

I found myself having to react playfully rather than construct carefully, and to perform with the evolving images. This was about developing an intuition around the interfaces - a tacit knowledge of the behaviour of feedback.

Aligning the Sweet Spot

The alignment of camera and display is the key starting point for feedback, enabling it to resonate. Keeping it steady on a tripod was important to allow patterns to form sustainably, but achieving precise alignment was difficult. Working with a digital projection mapping tool like Isadora was a neat way round this, allowing me to easily map the corners of the camera's view of the screen or projector.

Simple Strategies

Rotation is a useful strategy for adding symmetry. Inversion of light and dark (sometimes possible in camera) is a fairly reliable method of pattern generation. Zooming out creates a mise-en-abyme, whilst zooming in pushes the image to abstraction.

Digital Affects

Digital software such as Isadora provides many tools for treating the video feed, beyond the alignment of camera and display. From carefully calibrating contrast, or shifting the hue and saturation, to more extreme treatments such as colour thresholds, chromatic keying, inversion, dither, or even time-based video effects and delays.

Optical Interfaces and Light Lathes

Cameras are fantastic interfaces for interaction - anything placed in their field of vision simply becomes part of the work, and this allows for very intuitive user interaction. Poking my finger into a spinning ball of rotational feedback was like pressing a chisel to a lathe, giving the material form. It felt sculptural.

Vidwifery

I often felt like I was trying to coax these forms into existence. It was a very delicate balance that needed care; reducing the ambient light, and making minute adjustments to the angle or diaphragm of the camera. My usual methods of working with video - capturing, cutting, stitching, exporting - now seemed more like crudely assembling Frankenstein's monster. Instead, these nascent images emerged from nothing but a seed of light, and only if the conditions were nurturing. I imagined myself as a midwife, bringing a newborn into the world, watching it grow.

Mixing It Up - Internal Feedback

Working with analogue video mixers and titlers was a great way to introduce colour and effects into the feedback system. The images had a very distinct palette, and patterns seemed to drift down the screen like snow. Video Titlers added their own text generation into the mix, constantly re-seeding the feedback with words, rippling the pool. It was also simple to create internal feedback

systems, without a video camera, by making a figure of eight using composite cables between machines.

Self Hypnosis

Feedback is both mesmerising and meditative. I frequently lost track of time whilst generating these textures, giving some truth to Bill Gwin's (1971:4) warning about being 'caught up in the process of discovering it to the exclusion of anything else'. Still, I found it therapeutic to just *be* with the feedback, much like one would draw comfort from a fire in the hearth.

Forms in the Feedback

Like Hofstadter, I felt compelled to interpret the patterns and forms I saw, and label them. Variously, I observed: a jade dinosaur egg, worms dancing in concentric rings like a Busby Berkley choreography, micro-organisms, waterfalls, slime, foam, cheese, fire, leaves, rain, craters, pearls, zebra stripes, leopard spots, ripples in a pond, a maze, origami, shells, buffering, Celtic knots, flowers, lava, sound waves, a circus tent.

Democratic Devices

Though each different camera or display affected the nature of feedback form, the broader lesson was that regardless of the model, I was always able to get 'something' happening. The Vasulka's assertion (Gill 1976:1) about the democracy of video is even more relevant today, given the affordability and variety of new and especially second-hand equipment. Camera + display = feedback.

opening portals

to new organisms and

circular networks

Chapter 4

Final Forms in the Feedback Forum

4.1 Format

Building on my Video Voyages, I created several Final Forms - more developed works that could demonstrate alternative approaches to video feedback. Some of these pieces have their origins in experiments I made years ago - such as Video Culture[23] - whilst others, like the Laptop Loop, were only undertaken the week before the presentation.

For the sake of brevity, I have chosen to focus on three of the five works presented in the Feedback Forum. I believe these pieces to be the most significant as they combined traditional analogue / optical feedback systems with digital software tools. They were listed for the participants as follows:

PORTAL

Projection mapped disc - red / yellow spirals

camera, projector, disc, Blackmagic Intensity shuttle, laptop, Isadora software

LAPTOPS

Laptops arranged in a 6-degree feedback system x 3 (changes every 2 mins)

laptop x 6, usb webcam x 6, Isadora software

VIDEO CULTURE

Projection mapped feedback environment - red, green, blue can be 'grown'

video camera, projector, disc, Canopus ADVC, laptop, Isadora software, laser pens, black card

[23] This system was initially developed in 2014 ('Video Culture 1.1, Staro Riga), and repurposed for exhibition in 2017 (Concrete Connexions, Barrow-in-Furness). This latest iteration completely rebuilt the video culture system as a performance tool, revising the chroma-feedback calibration, and incorporating a new projection mapping system and a midi-interface.

I invited a group of 6 experts within the field of digital arts to engage with the pieces and and take part in an open discussion reflecting on the experience. The works were installed in a blacked-out studio at Manchester School of Art. The panel were provided with a map of the space, a basic technical description and working title of each piece (as above), but no instructions as to how to engage with the works. The group were given approximately 30 minutes to explore the space and engage with the works, and the subsequent discussion lasted a further 50 minutes. Comments from participants have been included in my analysis of the works, and will also form part of my overall conclusion.

The panel came with an important range or expertise and experience within the digital arts, as artists, designers, producers and curators. I have attributed their comments in my analysis to give a better sense of the context and perspective each participant brought to the discussion.

In alphabetical order:

- Idoia Acha (IA) - visual / sound artist, graphic designer
- Daniele Baron (DB) - Interactive Producer - Centre Screen, Manchester
- Dan Conway (DC) - visual artist / motion graphics - Immersive Ltd
- Dan Lusby (DL) - Senior Motion Designer - Centre Screen, Manchester
- John O'Shea (JoS) - Head of Programming - Science Gallery, London
- Irini Papadimitriou (IP) - Creative Director - Future Everything, Manchester

4.2 Form 1: ‘PORTAL’

Figure 4.2.1 - ’PORTAL’ - Holden Gallery, Manchester (Sam Meech, 2019)

Synopsis

A large circular screen displays a projection mapped feedback system - complex patterns, digitally coloured and manipulated using the software Isadora. As users enter the space of the camera / projection, they trigger a series of visual ripples that soon become abstracted, forming new patterns. Interactions also trigger layers of sound that reinforce a sense of entanglement. The work references science fiction and the notions of windows in space time, and has been exhibited in libraries and galleries.

Hardware schematic

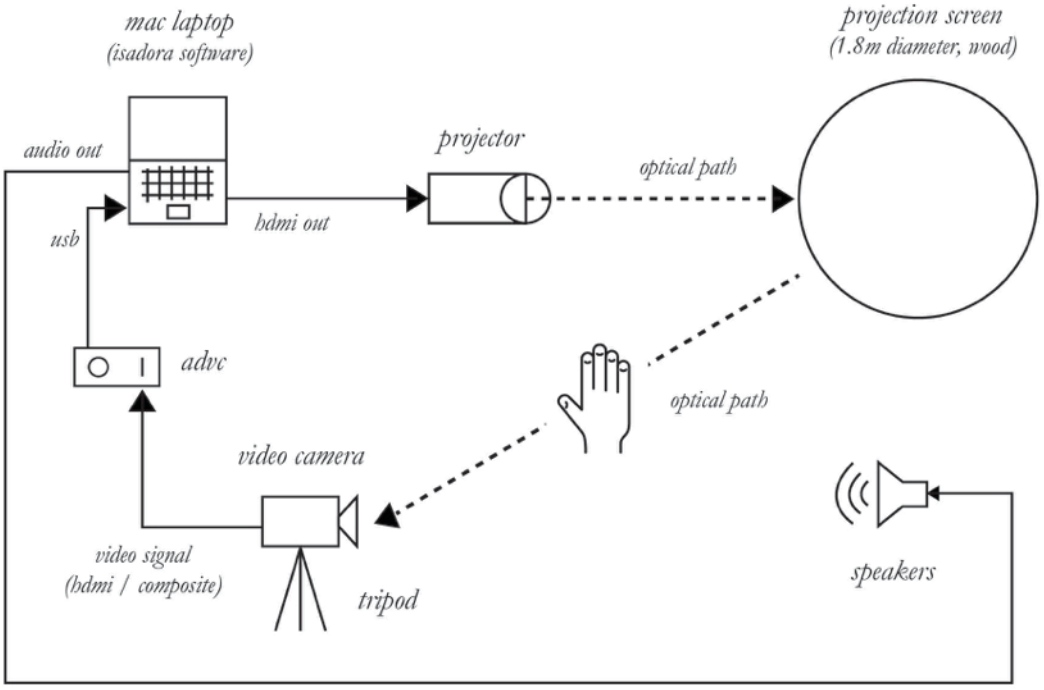


Figure 4.2.2 'PORTAL - Hardware Schematic', Sam Meech 2019

Generative Properties

The key generative power of the PORTAL comes from a precise alignment of camera input to projection output, achieved relatively easily using the projection mapping tools within Isadora. This creates a stable environment in which more disruptive visual manipulations (again controlled by the software) can take place. In particular, PORTAL uses a threshold inversion of the image (eg light to dark) to provoke a constant oscillation of luminance within the feedback loop. Mapped at approximately 1:1 scale, this inversion tends to generate 'Turing patterns', whilst demonstrating the properties of a reaction / diffusion system. In combination with variables such as zoom and rotation (again managed by Isadora), this simple

technique can generate innumerable fractal forms.

Optionally, switching to automatic exposure and white balance implicates the cameras' own internal negative feedback systems as it tries to 'read' the image and adjust accordingly. This can at times produce detailed cellular patterns with great colour depth, depending on the scene.

Additional video effects available in Isadora (flip, dither, hue, etc) allow us to easily alter the graphic treatment of the feedback, and by implication the generative behaviour. For instance, shifting the hue slightly will conjure cycles of colour, whilst flipping the image on the vertical axis will give rise to the formation of zebra stripes. The automation of timed transitions between variables adds a further layer of animation to the image.

Interaction

Users interact simply by entering the view of the camera and / or projection. The interface is intuitive - placing emphasis on the user's own presence and movement in a direct engagement with the feedback. Any disturbance of the image by the user creates temporal ripple effects within the patterning. The human scale of the work allows audiences to place their whole bodies into the feedback loop, encouraging them to create their own choreography within the space. Interaction is 'rewarded' by the triggering of audio. Persistent engagement unlocks additional layers of sound, reinforcing the sense of entanglement with the work.

Sound

PORTAL has three levels of sound, designed by composer Tom Rea Smith, to

create a warm and relaxing sonic environment of interaction. Firstly, a gentle background texture of dry rustling papers or swirling leaves accompanies the PORTAL's steady state. When a user enters, they trigger a series of 12 chimes, depending on where they are positioned. Sustained interaction unlocks a third sonic layer - a growing swell of reverberating jangles, building to an orchestral climax. After a user leaves, this soundscape dies down, returning to the steady rustling.

Aesthetic

The primary aesthetic of the PORTAL comes from its basic physical form - the circle. As a glowing projection mapped disc placed within the space, the screen creates a powerful optical illusion that suggests an interruption in space / time, with references science fiction (eg Stargate). The circular shape of the screen makes the use of concentric zooms and rotational symmetry within the feedback particularly effective.

PORTAL also draws on the digital video effects present within Isadora. The use of coloured Threshold Inversion (red / yellow) has enabled me to produce a striking motif as a starting point for the work. This technique has a tendency to generate organic patterns that recall nature (giraffes, zebras, water, bacteria, shells). The aesthetic is also shaped by the user placing themselves in the work. PORTAL contains visual echoes of interactions - hands, arms, faces, bodies - that momentarily form a figurative mandala before transitioning into abstraction and pattern.

Finally, depending on the resolution of the camera, projector and the software video processing settings, variations in granularity of patterns (and thus

behaviour) can be explored with increasing depth and detail.

Opportunities

The Isadora software provides further options for exploring the visual treatment of the feedback, with each digital manipulation of the image producing a different pattern generation behaviour.

The intuitive interface encourages a deep, expressive interaction with the whole body, and even allows those with limited mobility to participate and shape the work. This could be developed further in the context of performance and dance.

The simplicity of the circular format makes PORTALS very scalable - in prototyping the work I developed a series of 'petit portals' powered by pico projectors. These could exist as primarily generative works, to be hidden in unusual environments.

Restrictions and Repeatability

The movement of people in the installation environment means care must be taken to avoid knocking the camera. The space must be dark enough to accommodate the projection to a reasonable degree of contrast, but generally, a reliable setup can take place relatively quickly in a variety of contexts. The range of calibration offered by Isadora (projection mapping, colour balance, threshold, etc), and the power of the inversion technique, means that even with less than ideal conditions, a level of generative patterning can be achieved.

Forum Feedback

Whilst users could place their body in the work, triggering echoes of their own silhouette, the group drew a distinction between PORTAL and works that function primarily as digital mirrors, such as those of Daniel Rozin (Wooden Mirror) or Rafael Lozano Hemmer (Shadow Box series). As the reflection was not foregrounded - 'you can't really see yourself' (DC) - the piece avoided falling into narcissism. Interaction with PORTAL was less like a mirror and 'more like a ripple in a pool' (JoS).

PORTAL proved to be an intuitive and expressive interface - especially relevant for those working within the museum industry, in which exhibits must be user friendly and engaging.

> You established how it worked quite quickly. Just with a single hand movement you understood how it was repeating, and the textures that you might get out of that. (DL)

> But once you knew how it worked, it didn't become boring… It allowed you to be intuitive. It's not an instrument, but it's something that you're aware of your sphere of influence. (JoS)

Idioa Acha, an artist and designer working with feedback took this idea further, suggesting that the interactive aspect of PORTAL was also the mechanism for understanding the generative behaviour of the work.

> It was not so much that I wanted to see myself in the piece…thanks to my movement I could work out a bit more… you're more embodied…That intuitive sense is a bit like playing something or if you're navigating something. It's not so much that I could work it out, but I could ride it somehow, without knowing…like if you're sailing, you know you're in control somehow. (IA)

Acha's comments highlight the experiential sweet spot of chance and control, drawing on the tacit knowledge of being in one's own body. Having previously produced the SUPERSENSES exhibition at the Science and Media Museum (2017), John O'Shea reflected on the science and technology of perception. He suggested that interaction with the PORTAL was an example of the role movement plays in allowing us to get our bearings:

> There is a direct relationship between our movement and vision and our capacity to be able to perceive. So if you physically move, at an evolutionary level, instinctual level, your movement will enable you to see, and to look more clearly. So I think that act of tuning in to it is important. (JoS)

This act of tuning in to the piece was also enhanced by the sound design, which was felt to be "subtle", creating a comfortable space for people to be in. Though in the context of a shared exhibition space, the sound would have benefitted from some containment, the sonic elements "definitely had an influence on situating you, like a sort of embodied experience." (JoS)

Summary

In summary, PORTAL demonstrates how a simple use of digital projection mapping can be an effective approach to calibrating and enhancing the generative potential of video feedback. PORTAL's circular screen rejects the traditional rectangular format, framing a powerful yet flexible pattern generator that is visually captivating for audiences. The real feature however is the intuitive interface that amplifies and echoes the presence and movement of users in a manner that is engaging and relaxing, inspiring analogies with natural forms such as water. This facet demonstrates how the arrangement of camera and projector that produces the generative element of the work can also function effectively as the interactive interface. Though users sense their influence on the work, the piece

stops short of simply being a ‘magic mirror’, whilst the human scale of the screen opens up the interface to encourage an expressive interaction with the whole body that leads to choreographic play. Finally, PORTAL’s use of sound design proves to be an effective strategy for keeping people comfortable within the space of work, and enhances their interactions.

4.3 Form 2: ‘Video Culture’

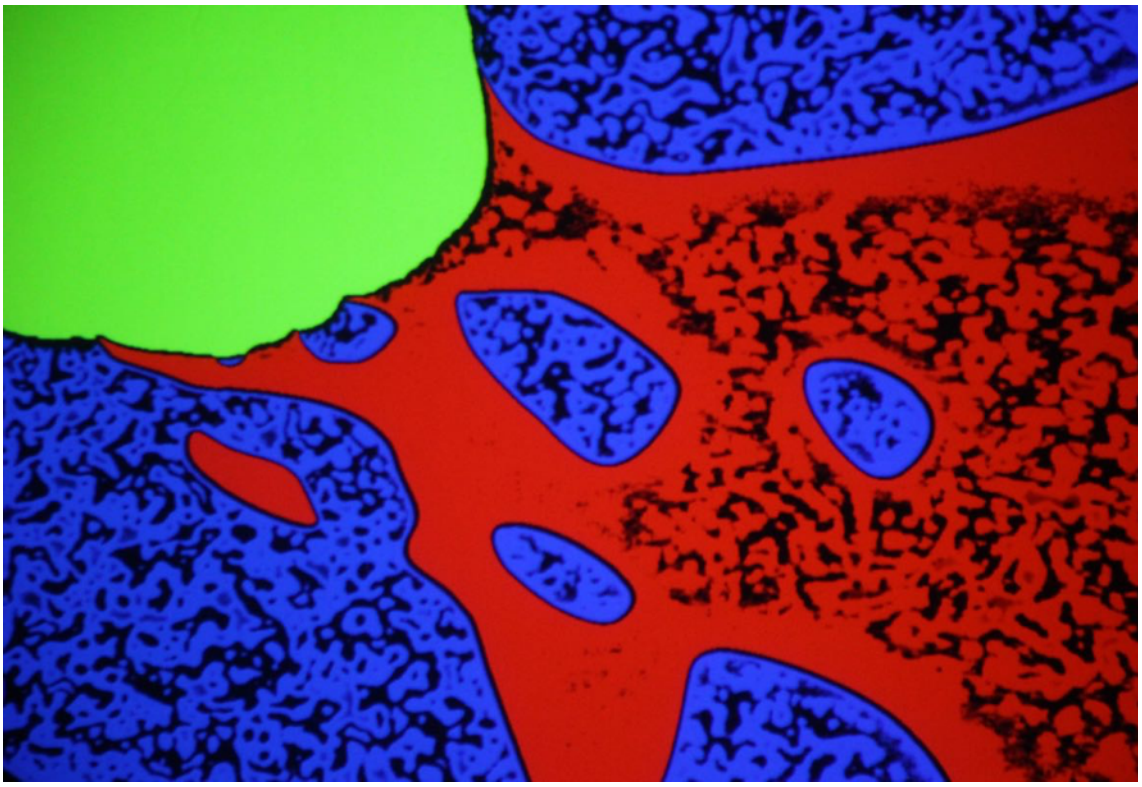


Figure 4.3.1 - ’Video Culture (detail)’ , (Sam Meech, 2019)

Synopsis

Three discrete chromatic feedback systems (Red, Green, Blue) exist in the same space, fighting for territory like organisms in a petri dish. The work is seeded using coloured laser pens, whilst the careful mapping of camera and projection encourages each coloured ‘culture’ to grow steadily to fill the screen. The system expands to occupy the shape of any given screen, even irregular forms. The presence of each colour is linked to a sound library, generating a shifting composition that can be easily shaped by the user.

Hardware Schematic

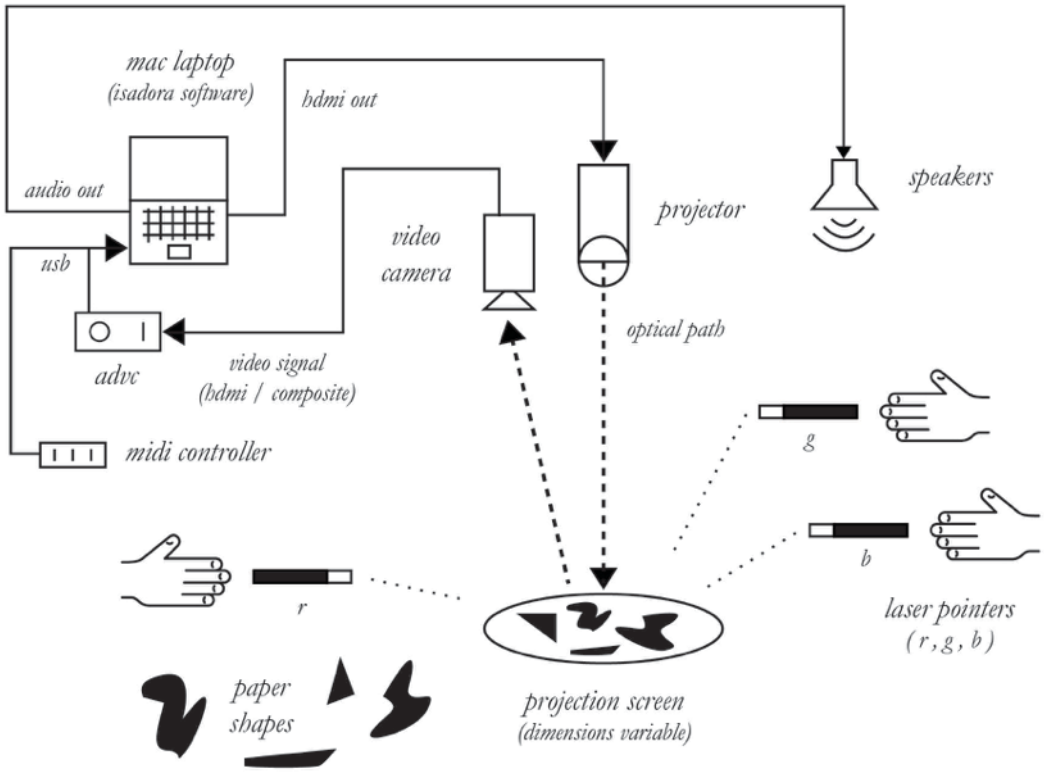


Figure 4.3.2 'Video Culture - Hardware Schematic', Sam Meech 2019

Generative Properties

Video Culture draws on the basic power of optical feedback as a visual amplifier, but channels this growth through 3 distinct mono-chromatic systems to produce unusually microbial behaviour. Each colour enhances itself, propagating within the feed and growing on the screen: green generates more green, red reinforces red, and blue breeds blue. Conversely, as these are discrete systems, different colours inhibit one another, creating conflict within the optical space. As each colour expands, it will eventually bump up against another, and against the edges of the screen. This creates a constant flux as individual colour growth is amplified by the feedback system, yet inhibited by the other colours sharing the space.

A second generative dimension is the emergence of texture and pattern within each colour, depending on the chromatic resonance. Shifting the KEY HUE of the CHROMA KEY actor will misalign the input and output hues, resulting in reaction diffusion patterns. Much like tuning a radio dial away from a station, as signal strength decreases, noise and interference begin to block out (or in this case 'black out') the broadcast. In Video Culture, the feedback mechanism locks in the interference, causing it to reverberate across the signal and resulting in grainy textures like sand dunes or rippling water.

Interaction

Interaction is shaped around encouraging or inhibiting growth of the chromatic video forms. The laser-pen is the primary interface for 'seeding' the work with colour, allowing users to easily 'draw' within the projection space. A user can add a single spot of coloured light and simply watch it grow, or seed multiple cultures within the space. To 'kill' the growth of colour within the feedback loop, a user simply places their hand in front of the camera, blocking the light.

This basic dynamic becomes more intricate once the additional colours are incorporated. A user can 'paint' a first colour (eg blue) within the feedback loop before 'burning' through it with a second (eg green), giving rise to new chromatic islands. Of course, this interplay of form and colour becomes even more complex with multiple users and laser pens. Co-operative or competitive strategies may emerge as users explore their own creative agency within the shared space of the feedback loop. For example, 'red' users may work together to 'burn' through green more efficiently in a fight for dominance, or collaborate with a 'blue' user in a mimetic drawing game.

An additional level of hands-on interaction can be incorporated through the use of coloured paper 'masks'. Black paper of any shape can be placed on a white screen to create 'dead' spaces - trenches where the projection is not reflected and so colours cannot propagate or pass through. Inversely, white paper 'masks' on a black screen will define a 'live' space for the video cultures to grow.

Sound

The balance of colour is emphasised sonically, with each chromatic channel linked to a corresponding audio channel. This audio channel contains sound samples and audio effects, including reverb and feedback. Thus, user interaction with the laser pen (seeding) and the camera (blocking) triggers a dynamic soundscape that reinforces the sense of entanglement with the image. The audio can even function as the primary form of engagement, as users opt to compose sound first, regarding the visuals as the secondary element. The sound has been designed and performed by musician Raz Ullah (Manchester, UK) and composer Tom Rea Smith (Liverpool, UK).

Aesthetic

As the function of the piece relies on three discrete colour channels, Video Culture possess a distinct tri-tone palette that suggests the 3-bit RGB (0-255) of screens. By contrast, the forms these colours take - shaped by their evolving interplay - feel far from technological, evoking natural phenomena such as bacteria, lava, or islands in water. The emergence of patterns within these territories of colour create a shifting texture that adds to their organic appearance. Finally, the aesthetic of the piece is shaped by the form onto which it is projected, and within which the video cultures must grow - whether a simple rectangle or circle, a more complex custom

shape, or a series of movable masks.

Opportunities

The multi-player interface has the potential to develop distinct roles within interaction, whether that be collaborative, competitive or asymmetrical, that will inform interpretation of the work. The screen shape (and its orientation) could be explored further to provide a variety of contexts for this interaction. A circular screen might suggest a petri disc, creating a discussion around microbiology, whereas combining a rectangular world map with moveable masked areas could suggest shifting political territories.

The piece can also be developed further as an instrument for audio visual performance. This is largely thanks to the simplicity of the laser pen and camera lens as intuitive interfaces. The expressive control they give a musician / composer / performer over the sound and image is both effective and remarkable. This would be enhanced by experimentation with different audio libraries and sonic textures.

Restrictions and Repeatability

This optical system is highly sensitive to small changes in luminance and colour. The camera and projector bring many variables (distance, model, lens, exposure, contrast, brightness, colour space, white balance, etc) that require calibration. Spaces need to be very dark to avoid contamination of light and to provide sufficient level of screen contrast, making it difficult to find suitable venues for performance or exhibition. Even the materiality of the screen surface itself affects the behaviour of the video cultures - with some veneers creating a slight diffusion

of light that causes colours to grow too rapidly.

Forum Feedback

For the Feedback Forum presentation, a circular screen (a white table-top) was placed on the floor, and the projector mounted vertically above. Black paper shapes were scattered on the screen. This lower arrangement, with users stood around the work, seemed to stimulate analogies as to the activity they were engaged in:

> I thought of gardening, and kids, and having some sort of project where you're creating worlds, and I felt like playing with other people "I'll do that and you do that, and we'll make this together". It felt really co-operative… There's an element of care, but it was like trying to encourage a flame sometimes… I think because we were playing together I had more of a like "lets get this fire going". (IA)

> There was a co-operative aspect to it. At one point - I don't know who else was there - but I could see that my bit is going to start taking over and I need to try and clear some path. (JoS)

The concepts of garden, campfire, or sandbox carry positive, collaborative associations with the landscape and nature - nurturing forms from the ground up whilst regulating any impact on the shared ecology. However, for other users, the ability for colours to 'erase' one another meant the screen became a 'battlefield' - a series of territories to navigate and conquer.

> It felt like a game to me, where you take over the map .. I enjoyed that, fighting Dan for the map area. (DB)

> It's RISK isn't it? (DC)

Whether competitive or co-operative, there was a deep sense of engagement with the coloured forms and an appreciation of the multi-user dynamic. This prompted

suggestions of developing the scale of the work and the range of user 'roles'.

> I could really imagine that being at a larger scale. You could have a lot of people interact with that… It's about getting the right level of intuition, that you know what you're actually controlling, versus it doing surprising things. But it's loads of fun, it was really engaging. (JoS)

> I thought of stage shows, but then I thought "an audience with laser pens?" (DC)

> You could encourage interaction with the cut out shapes as well. That felt like it was something you shouldn't be interfering with or changing, but that could be a whole other option… two people with a laser pen, somebody else with the shapes. (DL)

Since no explicit instructions were given, the group were initially hesitant to move the black paper shapes, however, they quickly grasped that these added another level of interaction. They allowed users to sculpt the confines of the screen, and direct the flow of the colours. Dan Lusby's suggestion of these card shapes being operated (or even created?) by a third user would be an intriguing asymmetrical dynamic to explore.

The final talking point for the group was the sound design of the piece. Sadly, in this instance the reactive mechanism was poorly calibrated, and lacked the sensitivity or impact of previous and subsequent exhibitions. Still, the 'passive' sound played a small role in attracting the users and keeping them within the space of the installation.

> I did like the sound. I spent quite a bit of time there just meditating. (IA)

> The passive sound of it was intriguing… It sort of made you want to go and have a go. But then once you were actually playing with it, it didn't feel like the audio was being generated by you, and it felt like that was going to be the payoff almost? (DL)

This last example highlights the difficulty in calibrating optical systems, and the knock-on effect this can have on other interactive elements such as sound. This may not apparent to all users, but for some there will be a clear sense that the expected reinforcement of interaction - or 'payoff' - is absent.

Summary

In summary, *Video Culture* is an unusual use of optical video feedback, concerned less with psychedelic optical effects and pattern generation, and more with the potential of colours themselves to be interfaces. The use of chromatic channels as filters enables three distinct feedback systems to occupy the same space. This mechanism results in some freakishly (micro)organic interplay between the coloured video forms, and by extension, the users. Within the Feedback Forum, the discussion centred not on the aesthetic but on this multiplayer interaction, suggesting this system could be explored further as a game. The laser pen itself is an intuitive interface that provides numerous analogies to the interaction; from a pen that illustrates, to a weapon that burns, a magic wand that conjures life forms, a syringe that injects micro-organisms, or even a conductor's baton arranging a chromatic symphony. Though the reactive sound element did not function correctly for the Forum presentation, my experience in seeing the installation 'performed' by artistic collaborators (and audiences) reinforces my belief that the work can be developed as an audio-visual instrument. This application however, depends on it being correctly calibrated both for sound and image. This last point is the key caveat; the recurring analogy of micro-organisms may be pleasingly organic for a 'digital' artwork, but it also betrays an inherent sensitivity to exposure. It has yet to be properly established to what extent Video Culture can survive beyond the confines of the lab.

4.4 Form 3: ‘Laptop Loop’

Figure 4.4.1 - ‘Laptop Loop’, (Sam Meech, 2019)

Synopsis

A circular daisy-chain of feedback ‘nodes’ constructed from laptops and webcams. Each laptop uses a USB webcam to 'watch' the previous laptop, and display the output on its own screen, which is then ‘watched’ by the next laptop in sequence, and so on, eventually creating a LOOP. Using simple projection mapping tools, the arrangement creates a distributed, multi-layered-feedback system that can be scaled-up depending on the space and the availability of equipment. The installation cycles through several preset ‘scenes’ - combinations of real-time video effects, and additional digital images - that alter both the aesthetic and behaviour of the feedback.

Hardware Schematic

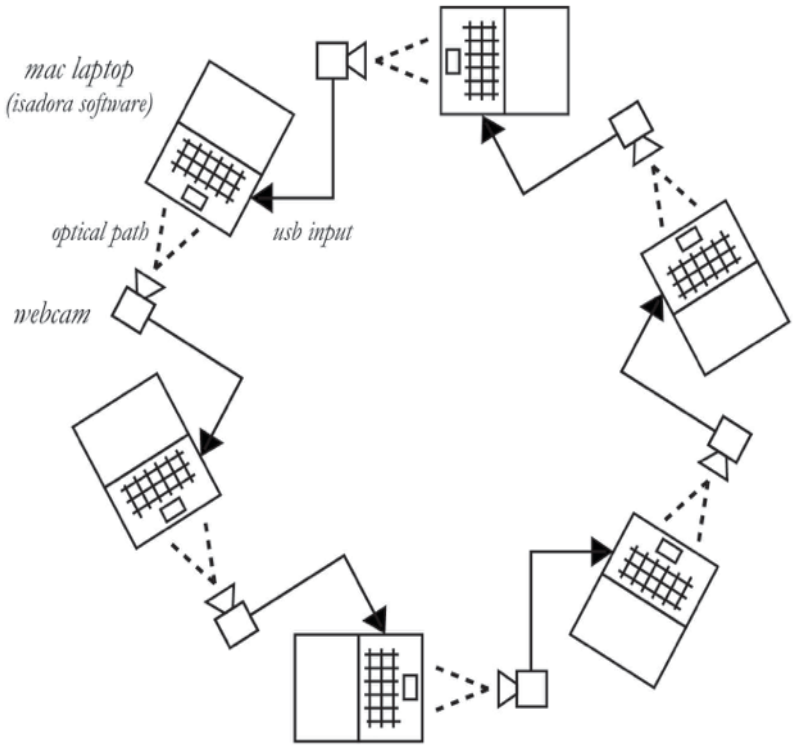


Figure 4.4.2 'Laptop Loop - Hardware Schematic', Sam Meech 2019

Generative Properties

A number of factors shape the generative behaviour of the Laptop Loop. Firstly, rather than a single system, the video feedback 'engine' is distributed across several nodes as an inter-dependent whole. Each node adds a degree of latency, meaning that visuals take longer to feedback as they must first travel round the entire loop. The effect of this temporal fragmentation is that images (whether introduced digitally or optically) take longer to form, and decay at a slower rate. The laptop loop is a much deeper echo-chamber than a single-system feedback loop.

The second generative facet is the graphic treatment of the video feed, as managed by the Isadora software. Techniques such as threshold inversion, (as seen in PORTAL), contrast, hue shift, or delay, all exhibit distinct visual styles, and consequently produce different behaviours throughout the LOOP. Isadora also enables us to momentarily introduce digital elements to the feedback (text, graphics) that leave their own temporal 'stamp' on the feedback.

The final fertile factor in this circular configuration is the webcam. The automatic white balance and exposure of these everyday devices constantly adjusts in response to the screens luminance - closing the iris when over-exposed, or opening up if the image becomes too dark. This internal negative feedback mechanism acts as a chaotic counterbalance, endlessly agitating the pool.

Interaction

Laptop Loop is primarily a generative rather than interactive installation. That being said, the webcams provide a simple optical interface for users to explore, though the scale of the screens limits interaction to placing hands or small objects (phones, card shapes) in front of the camera. However, the multiplicity of screens /cameras enables more than one user to impress their image within the feed at the same time. Due to the added degrees of latency, users must keep their hand in position for a few seconds in order for the image to 'take'. A useful analogy might be that of pressing a hand on a frosted car window; a momentary contact will barely make an impression, but holding the hand in place will melt the frost and leave a clear print that lingers.

Sound

Sound has not been explored in this work to date.

Aesthetic

There are two inter-related aesthetic features to the Laptop Loop - the images forming onscreen(s) and the sculptural arrangement of the hardware.

The quality of images onscreen is determined by the video effects employed within each scene in Isadora. As with PORTAL, techniques such as inversion and colour threshold produce reliably concentric echoes (albeit rectangular in this case) and strong reaction-diffusion patterning. Scenes that simply enhance contrast create blobby orbs of light that drift like a lava lamp. In general, the rhythm of animation feels slower than the responsive rippling pool of PORTAL, as if the forms are suspended in a thicker video substrate.

The unique aesthetic dimension to the Laptop Loop is not within the screen, but between screens, as the circular format gives a sense of motion around the loop. The auto-exposure mechanism of the cameras at times produces a strong 'pulsing' behaviour that is reinforced as it travels around the loop. This can be accentuated by displaying the piece in a darkened space, lit only by the screens themselves. The cyclic presentation of equipment creates a sculptural experience for the audience. The work is as much about the laptops as the images - we must consider the role of this everyday technology and the associations that brings.

Opportunities

The impact of this work comes from its sculptural loopiness and the scale of that loop. To that end, the foremost opportunity is in making the work bigger by adding more laptop / webcam nodes, and exploring the impact on the behaviour of the feedback.

The Isadora software presents many ways to treat the visual style of the feedback, and also to insert further digital assets (graphics, text) into the piece. These elements could be drawn from live data - eg twitter feeds - making use of each laptops network capabilities.

Restrictions and Repeatability

The use of screens rather than projection and the scaleability of the installation, make it relatively easy to present the work in any space. The main restriction is the availability of equipment (laptops, cameras) in bulk. Webcams are also surprisingly low cost - I was able to buy 100 Logitech cameras on eBay for £75. Working at the university allowed me to access several mac laptop trollies, but beyond institutional support, corralling a small loop together momentarily should be achievable given the availability of laptops in everyday life. Crowdsourcing equipment this way might be another interesting factor in the co-creation and interpretation of the piece.

Forum Feedback

As with other works, the group interpreted the patterns generated by Laptop

Loop using analogies from science and nature such as 'molecules' and 'fingerprints' (DC). Equally important as the texture onscreen was the movement *between* the screens, and the opportunities for interaction this enabled.

> The macs around table just felt like it was moving, but then you put your hand in, it creates that domino effect, but you could've just been mesmerised by just watching what was on screen already with the kind of black and white on one, and white on black on the other… There's a delay of half a second as the image was getting sent to the next one, and that's the domino effect. (DB)

The analogy of dominoes is compelling, holding within it a tension between stability and falling. There is an inherent temptation to reach in and tip the first domino and set the whole work cascading. Initially some of the group proposed complex explanations as to how the images were being sent between screen, suggesting the use of video over wifi. Though the actual setup was much simpler (albeit difficult to perceive in the dark space) the idea of including video streaming within a feedback system opens up many options for creating optical feedback systems that are not beholden to physical / spatial restrictions.

Aside from the image-making possibilities, it was the foregrounding of the physical hardware that proved to be the most engaging aspect of this work. The arrangement of screens and cameras inspired comparisons with historical media artworks, but also drew interpretations rooted in contemporary uses of technology.

> This is actually quite elegant as a sculptural set up… and although I think it does obviously draw on early media art experiments… I felt like there was a hint at a kind of narrative within it, almost like a social narrative - the idea of the webcams watching the webcams (JoS)

> It reminded me of the Internet of Things, and all things connected, and all the new G5 technology coming in and all these objects talking to each other,

being in a circle, so there was something quite current about that. (IA)

Video feedback is not just a potent pattern generator, but also a model for thinking about other forms of feedback such as technological networks, algorithm driven content, and social complexity. Whilst I had not intended at this point to create any commentary or narrative, it seems that the components of the system had begun to speak for themselves.

Summary

In summary, Laptop Loop uses everyday equipment to demonstrate how a feedback system can be expanded by degrees, introducing additional latency and mutation into the transmission of the image. This physical expansion pushes the work further into the realms of sculptural installation, with the circular arrangement of nodes being an obvious starting point (but not the only possibility) for a work about loops[24]. Foregrounding the hardware in this way encourages audiences to interpret not just the images on screen, but to reflect on the equipment itself as part of any commentary. Finally, the use of projection mapping software is simple but effective, especially given that the laptops running the software are already functioning as the displays for the feedback system.

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[24] Since making this work, I discovered once again that Douglas Hofstadter (2007:101) beat me to it, albeit with a much more literal demonstration of the 'Laptop Loop'. Hofstadter describes a game whereby a group of friends and colleagues are arranged into a circle, and then must carefully sit on each others laps - a 'lap loop'. It is a fun team building exercise, but it produces some unusual cognitive sensations, as Hofstadter describes, 'one feels rather baffled about what on earth is holding the loop up'.

I also came across artist Blair Neal's (2013) thought experiment on creating the 'biggest optical feedback loop in the world', by daisy-chaining a sequence of cameras and monitors. Interestingly, he also proposes incorporating wireless video via Skype, and suggests that such a system would have an extreme degree of latency that might prove interesting for interaction.

4.5 Final Feedback from the Forum

All three works demonstrate different uses of optical video feedback, and in turn, different approaches to image generation and user interaction. *PORTAL* utilises digital projection mapping on a large circular screen to neatly exploit rotational symmetry and pattern generation whilst encouraging whole body interaction. *Video Culture* combines projection mapping with chromatic calibration to make an unusual interface for multiple users to 'grow' discrete feedback forms with laser pens. *Laptop Loop* is a scaleable feedback sculpture that uses simple mapping techniques to work with everyday digital technology.

Beyond the individual characteristics of each work, the group offered some general insights about feedback. Firstly, a common observation was the "familiar" aesthetic and the "warmth" of the video texture. For curator and producer Irini Papadimitriou, acquainted with my previous knitting[25] works, the texture of video brought associations with textiles, as well as giving a 'physicality' to the image.

> It did give me this kind of textile feeling in a way, in terms of patterns and textures…there is a physicality to the actual work that you see, (but) also in terms of what you see on the screen…Maybe that's the reason why it has this kind of warmth rather than just feeling that you're in-front of a screen. (IP)

Just as important as the perception of 'physicality' within the images was the tangible physicality of the hardware - cameras, laptops, cables and all. The

[25] Since 2013, my interest in analogue / digital hybrids has been expressed through a very different medium, that of knitted textiles. I have tried to explore many of the same things I enjoy about digital design processes through machine knitting, working with both hacked digital and mechanical punchcard machines. This has resulted in everything from lo-res looped animations ('Knitted Horse Firework', 2014), to large scale data visualisations, ('Punchcard Economy' banner, 2013), and even a range of knitwear ('Binary scarves' 2017-) that encrypts ascii-text quotations within a punchcard pattern.

interpretation of the works could not be divorced from their conspicuous material and technological footprint. This runs counter to the black box approach of much contemporary digital art, whereby the mechanics - both equipment and code - are largely hidden or disguised.

> Whenever you have feedback directly within a system like that, you are essentially creating at some level a conceptual work, because the material is part of the narrative of the work. So there's that kind of self-referential loop within whatever you are creating, that will always at some level be anchored with practices of the 1960s and 70s (JoS)

As beguilingly beautiful as the resulting images may appear, video feedback works are often as much about the system that creates them; the equilibrium between the equipment, the theatricality of the arrangement. Being technically and conceptually self-referential, a video feedback work speaks both to itself and of itself.

following the loop
the beginning is the end
is the beginning

Chapter 5

Conclusions

5.1 Closing the Loop

We have come full circle, from the origins of video feedback to addressing its disappearance in practice and theory, before surveying contemporary artists and evaluating new feedback experiments. Over half a century after its discovery, there are signs that this lively looped technique still has the potential to fascinate artists and audiences alike.

Video feedback can be integrated into a range of live systems and artistic processes that include video, film, movement, interactive design, sculpture, installation and performance. It has been used as a chaotic agent to remix video and film, and as an intuitive interface for interactive installations. We've seen its self-referential configuration employed as metaphors for emergent planetary consciousness and for the death of the author. Feedback can suggest an infinite multiverse, or encourage us to question our relationship to the here and now. It can generate hypnotic patterns that point to evolutionary principles, and create fragile ecologies of video forms that behave like micro-organisms.

My own works with video feedback incorporate a number of approaches from the artists mentioned in chapters 1 and 2. On the one hand they reference the self-reflexive practices of the 60s and 70s, foregrounding the components of the system. At the same time my works use digital techniques such as projection mapping, and attempt to engage audiences through expressive interaction. Pattern generation also plays a significant role in my Final Forms, and more recently my textural experiments with video mixers have drawn me towards the performative practices of the video synthesis community. Just as generative art should be regarded as an approach rather than a genre, video feedback can be folded into a number of other art practices as both a technique and an aesthetic agent.

However, there's no escaping the fact that feedback is predictably unpredictable. It is impossible to repeat precisely, often phasing between order and chaos. This key characteristic provides a compelling reason to explore feedback, but it may also be a barrier to working with it seriously, or at least consistently. Feedback's erratic nature is at odds with the demands of contemporary exhibition and commissioning - whether a gallery, light festival or performance - which generally require works to be robust and repeatable. Optical feedback installations in particular come with significant calibration issues - camera and display settings, and even variable ambient light - that present considerable challenges to artists making work for the public realm. Creating generative or interactive installations that function reliably is difficult due to the inherent hypersensitivity. What works in the lab often unravels on contact with reality.

Let us loop back on some key findings, before suggesting what further research might evolve from this thesis.

5.2 Feedback Findings

Hybrid Systems

Contemporary digital tools offer new strategies to working with feedback in a relatively reliable manner. Software such as Isadora and Touch Designer allow us to manipulate the video feed with a degree of control, before sending it back into the analogue dimension of optics. In particular, projection mapping tools offer a quick and reliable method to precisely align camera input and display output, creating a stable platform from which to explore other variables. Techniques such as chroma keying and threshold inversion elicit distinct aesthetics and behaviours that are easily customisable. For example, in Video Culture the simple use of

digital colour filters enabled three distinct chromatic feedback systems to exist in a single space, resulting in complex visual and behavioural dynamics.

Conversely, digital works can benefit by harnessing the power of feedback to generate chaotic complexity. This is particularly appealing for artists (myself included) who lack the experience or aptitude to work with code-based tools. Video feedback is an exciting and accessible 'pattern generator' (Doser, 2010) - a hands-on method for generative image making that doesn't require expensive equipment or specialist knowledge.

> Random is what we've been lacking so far in the digital age. By incorporating video into digital contexts there is the hope that "random" will be approximated. (Goss, 1996:2)

An analogue ingredient will add visual spice to a digital dish. The unstable oscillations of the electromagnetic wave bring a randomness and vitality that is exciting, especially to those used to working within the prescribed pseudo-randomness of digital interfaces and discrete numeric variables. The works presented in chapter 4 - PORTAL, Video Culture and Laptop Loop - all demonstrate the potential of the video as an unstable element within a 'fixed' digital framework[26].

Patient Performance

Video feedback is fundamentally temporal - a real time experiment that creates a volatile space for rapid evolutionary image making. Embracing the unpredictability requires a reactive mode of making that is rooted in performativity. Feedback can teach us to loosen up:

[26] A good recent example of this spicy analogue principle is artist Brent Patterson's 'VHS Sphere' (2019). Working with Blender 3D, Patterson uses footage from an old vhs tape to generate the surface texture for a simple sphere. This produces an unusual shifting geography of colour and form, that possesses a subtle vitality that bears the finger print of its analogue progenitor.

> The process of art making is one of discovery, not pedantry. Realtime motion imaging gives artists the same kind of freedom to tap the unconscious that painters have. These "revealed" images then become part of the culture and are slowly understood over time. They will never be discovered if the work has to be planned, plotted, justified, and rationalized in advance. (Goss, 2000:3)

Conjuring self-sustaining forms requires a tacit knowledge of video feedback and an approach that is responsive rather than prescriptive. The practice of *vidwifery* is about nurturing the signal, not forcing the frame. We must carefully feel our way to the sweet-spot where feedback becomes 'locked in'[27], through a mindful manipulation of camera alignment, zoom and exposure. Only then can the images emerge.

Potent Patterns

The reward for cultivating a performative sensibility and patient approach to calibration is a bounty of hypnotic imagery. The mesmerising pattern generation of feedback provides audiences with a meditative focal point for their attention, encouraging interpretation of the evolving forms. As we saw in the Feedback Forum, and throughout artists' accounts of working with feedback, there are numerous references to elemental and natural forms such as rippling water or flames. In an interview with Meigh-Andrews (2014:213) video artist Peter Donebauer, whose work was developed through live collaborative audiovisual performances, explains why the patterns and behaviour of video feedback might resonate so strongly.

> …the medium allowed a very fast exploration of abstract forms. By manipulating this technology to obtain feedback in certain ways, you created these forms which were recognisable. This was a form which could

[27] Hofstadter (2007:70) describes the robust and self-stabilising phenomenon of "locking in" as a circular justification - all that is needed to keep a pattern generating is the pattern itself. The video image is 'forever refreshing itself, feeding on itself, giving rebirth to itself'.

> be used to create nature itself - eddies of water, gasses or astronomical forms. You recognise those forms either because you've seen them before through scientific imagery, or because you recognise them in nature - in the whirls of a shell or something. Or perhaps they are strong, symbolic archetypes - certain shapes which touch deeply inside our past consciousness.

A remarkable feature of optical feedback systems is that when it comes to pattern generation, behaviour and aesthetics are interdependent. In short, how a feedback form *looks* affects how it *moves*. As we saw with PORTAL, introducing digital video tools into the mix allows us to easily (and dynamically) control precise aesthetic adjustments (colour, contrast, rotation, dither, etc) and even temporal modifications (delay, motion blur) that in turn beget new patterns.

Intuitive interfaces

Video feedback provides an intuitive interface for audiences to engage with artworks. PORTAL demonstrates how optical feedback and projection can easily be scaled to enable expressive interaction with the whole body. Users quickly comprehend that any intrusion into the view of the camera or the light of the projector will stimulate a ripple effect, as their actions are spatially and temporally echoed. This simple dynamic is engaging and yet relaxing, like throwing stones into a pond.

The necessary presence of cameras in optical feedback systems allow us to easily integrate additional interfaces (beyond the body) into an interactive work. Anything that can be placed in view of the lens, or be used to cast light or shadow, becomes to a means to influence the work. Video Culture incorporated two hands-on interfaces; the tactile paper shapes used to 'block' the growth of video forms, and the chromatic luminance of the laser pointers used to 'seed' the work. Finally, digital tools can also take advantage of the camera to perform image analysis and

camera tracking operations[28]. Video Culture and PORTAL both triggered sounds in this manner, by tracking the growth of colours or frequency of user interactions respectively.

5.3 Beyond the Screen

Though video feedback works are inherently self-referential and self-justifying, they consequently risk lacking any real purpose or context. At worst, the works exist as a kind of generative wallpaper or semi-sentient screensaver. More could be done to break out of the loop, and explore new environments and applications.

One site of investigation beyond the screen might be the context of the online network - multiple feedback systems that are connected by wireless streaming, unbound by space, cables or even conventional optics[29]. 'Laptop Loop' began to hint at the node as a conceptual model, and one or two of my video voyages have even incorporated video streaming within optical feedback systems, with the resulting latency and compression artefacts impacting the look and behaviour of the feedback forms[30]. Streaming platforms such as Twitch.tv and Youtube offer an accessible tool for potential nodes in a gigantic online loop, and the notion of a distributed feedback network opens up some interesting ideas around

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[28] The irony is that interactive installations using camera tracking must try to avoid accidental data 'feedback' from the screen - false positives so to speak. The aim is to track the user, not the projection! Typical techniques include infra-red lighting and filters, as well as the use of Kinect cameras that offer depth tracking on the Z axis.

[29] Screen capture software such as CamTwist can provide a digital 'eye' that can be trained on the display. Though it is not affected by any real world optics (ambient light, lens distortion, distance etc), it must still contend with issues of alignment, resolution and image compression.

[30] As part of my video voyages, I developed two experiments using video streaming - 'Video in the Abyss - big screen test', and 'Skype Twins'. The former used Twitch.TV to send the camera feed to a large screen, whilst the latter combined screen capture software with Skype on two laptops.

community, co-operation and co-creation[31].

Few feedback artists really explore the potential for either the location of the piece or the form of the projection screen itself to shape the work. As a most basic example, it seems unusual that circular screens have not been explored more often, considering that so many feedback artists employ rotation in order to propagate their video mutations by degrees. And what of more complex projection surfaces, such as irregular shapes or even buildings?

Where the work happens can be as interesting as the work itself. Optical feedback systems naturally exist in relation to their environment. There is porosity between the context and the work as the infiltration of external physical elements changes the behaviour of the system. Large scale LED screens are commonplace, and light art festivals provide a growing platform (and audience) for urban projection. However, optical feedback would prove extremely challenging to calibrate in an outdoor or urban environment, suggesting more work needs to be done to explore how such practices can exist in the public realm and at scale.

The beauty and tragedy of feedback is that it isn't repeatable. Each time we try to actualise repetition in this loopy world, we in fact get creation. Feedback doesn't feed-*back*, it feeds-*forward*, it feeds-*new*. By revisiting this early video art technique from a contemporary digital perspective, we cannot help but revitalise the practice of media art.

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[31] Artist Olivia Jack has developed online tools for the co-creation of generative art. Hydra Synth (2018) is a networked live-coding environment in which 'each connected browser window can be used as a node of a modular and distributed video synthesizer'. PixelJam (2019) takes this idea further to create a collaborative coding environment in which 3 remote users generate visuals within the same browser page. In both cases, as with Algorave, their is an emphasis on the display and distribution of the code itself.

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2.4.1 '*What is beyond the Hellraiser?'* video *(*Vallée, 2017*)* image © Guillaume Vallée 2017

2.4.2 '*Sight and Sound, Montreal'* performance (Stefan and Vallée, 2015*)* image © Sonya Stefan 2015

2.5.1 '*Japanese Firework schematic'* schematic diagram © Rob Feulner 2019

2.5.2 '*Video Art For Conditional Malaise'* video (Feulner, 2017) image © Rob Feulner 2017

2.5.3 '*The Bureau of Fugitive Dream Recovery'* video (Kop and Pharoah, 2019) image © Bureau of Fugitive Dream Recovery 2019

2.6.1 '*Innervisions'* installation (Richardson, 2018*)* image © Colby Richardson 2018

2.6.2 '*Feedback Camera'* installation (Robson, 2014*)* image © Louise Robson 2014

4 - Final Forms in the Feedback Forum

4.2.1 *'PORTAL'*- installation, Holden Gallery, Manchester, January 2010 *(*Meech, S, 2019*)* image © Sam Meech 2019

4.2.2 *'PORTAL - hardware schematic'*- diagram, Sam Meech 2019

4.3.1 *'Video Culture (detail)'*- installation, Elastic Spaces Lab, December 2019 *(*Meech, S, 2019*)* image © Sam Meech 2019

4.3.2 *'Video Culture - hardware schematic'*- diagram, Sam Meech 2019

4.4.1 *'Laptop Loop'*- installation, Manchester School of art, October 2019 *(*Meech, S, 2019*)* image © Sam Meech 2019

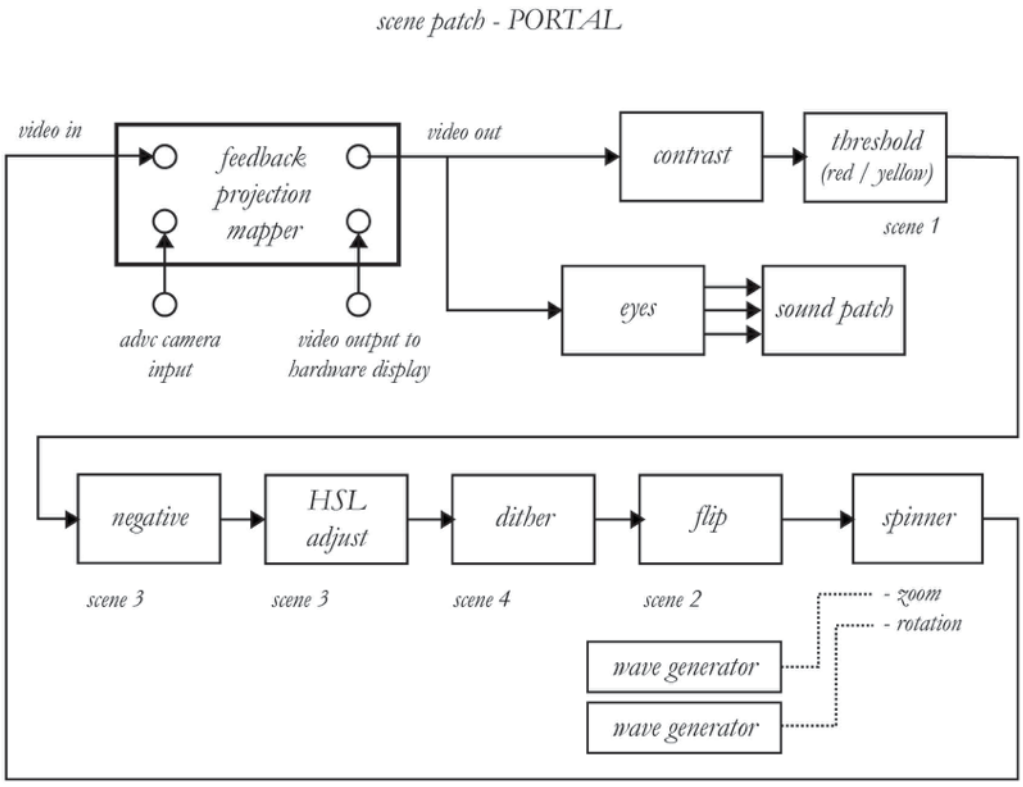
4.4.2 *'Laptop Loop - hardware schematic'*- diagram, Sam Meech 2019

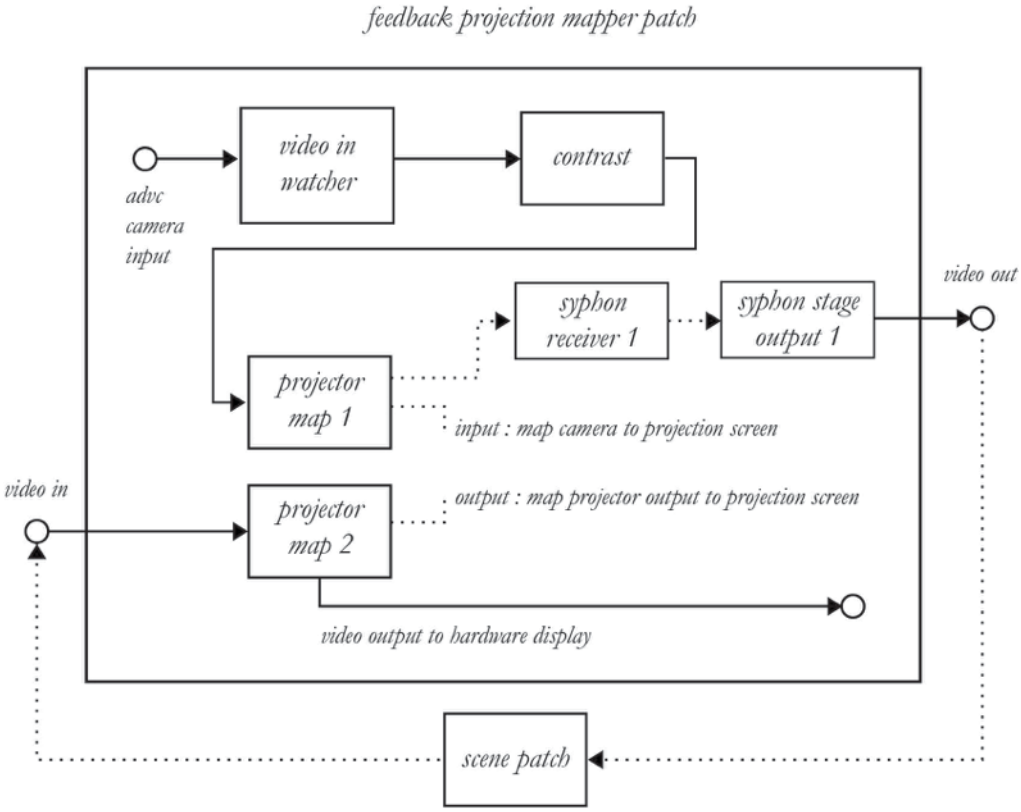
APPENDIX A

FINAL FORMS - SCHEMATICS

A1.0 PORTAL

A1.1 Software Schematics





A1.2 Hardware

- Circular projection screen (2m diameter - wood) - vertical
- Projector - HD if possible
  - BenQ W170
- Video camera or usb web cam
  - Sony FX1 / Canon XM2 DV cam with AV breakout to composite video
- Tripod
- Mac
- ADVC (analogue-digital-video-convertor)
  - Blackmagic Intensity Shuttle / Canopus ADVC 110 firewire / EZ Cap USB

- Sound card
    - Focusrite USB
- Speakers (stereo)
- Composite video cable

A1.3 - Software

- Isadora (Troikatronix) - video processing / projection mapping (Mac / PC)

A1.4 - Calibration

- VIDEO CAMERA
    - placed directly opposite screen on a steady tripod / affixed to table
    - Auto exposure / white balance optional

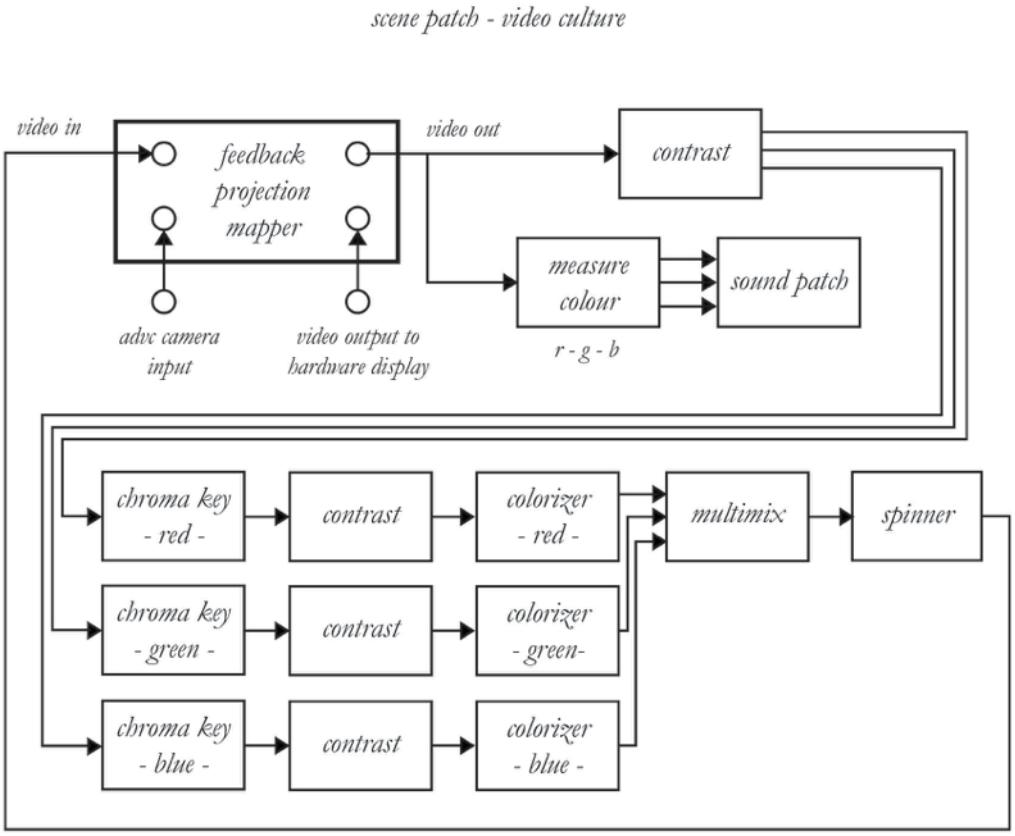
- SPACE needs to be relatively dark

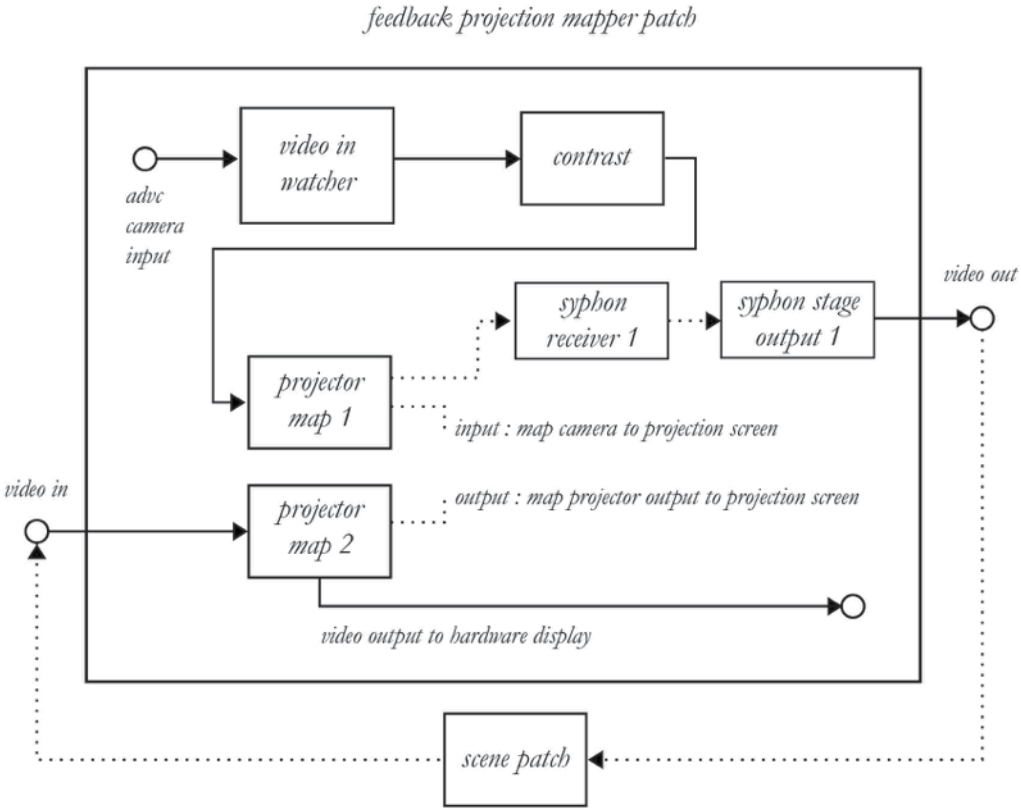
- SOFTWARE - ISADORA
    - PROJECTION MAPPING actor
        - ALIGN the input and output
            - map circular mask to camera input
            - map masked camera feed to projection output
            - map projection output to circular screen
    - THRESHOLD actor
        - INVERT light and dark colours (eg light = red, dark = yellow)
        - Find the threshold level so the image constantly inverts
    - CONTRAST / HUE / DITHER / SHIMMER actors
        - Experiment with different settings

- SOUND
    - EYES tracking
        - Adjust image tracking THRESHOLD
        - Set audio TRIGGER LEVEL

A2.0 Video Culture

A2.1 - Software Schematics





A2.2 - Hardware

- Projector or television - HD if possible, high contrast ratio
    - Forum - Infocus XGA projector
- Projection surface - shape variable, orientation variable
    - Forum: circular screen, floor
- Video camera with manual settings
    - Sony FX1 / Canon XM2 DV cam with AV breakout to composite video
- Tripod / magic arm
- Mac
- ADVC (analogue-digital-video-convertor)
    - Blackmagic Intensity Shuttle / Canopus ADVC 110 firewire / EZ Cap USB

- Sound card
    - Focusrite USB
- Speakers (stereo)
- Composite video cable
- Laser pens - red, green, blue
- Korg NanoKONTROL - midi controller (optional)
- White / black card shapes (optional)

A2.3 - Software

- Isadora (Troikatronix) - video processing / projection mapping (Mac / PC)
- Ableton - (optional if running sound outside of Isadora)

A2.4 - Calibration

- VIDEO CAMERA
    - place directly opposite screen on a steady tripod / clamp
    - WHITE BALANCE - manual or sunlight preset
    - IRIS / EXPOSURE - manual
        - Adjust to keep blank screen dark, but allow projection to be vivid

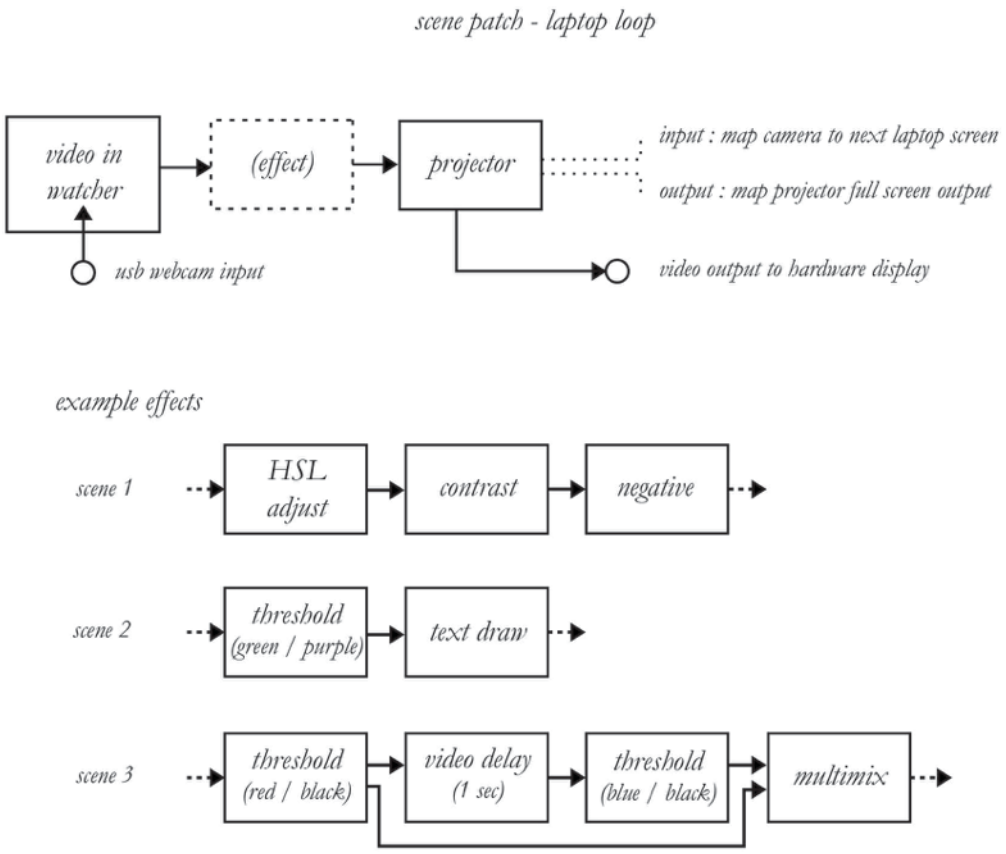
- SPACE needs to be very dark - avoid any ambient light on screen

- SOFTWARE - ISADORA
    - PROJECTION MAPPING actor
        - ALIGN the input and output
            - map circular mask to camera input

        - map masked camera feed to projection output
        - map projection output to circular screen
    - VIDEO IN (software cam)
        - Video feed must be calibrated to each camera can see a single colour (R,G,B), and filter out extraneous noise
        - CONTRAST - overall
            - Filter out low end of camera input - make all blacks blacker
        - CHROMA KEY actors (R, G, B)
            - Adjust KEY HUE and SATURATION to see only corresponding colour
                - Use laser / projected colour to test
        - Individual colours - enhance / inhibit each feed
            - CONTRAST - increase to enhance (bring top end down)
            - SPINNER - ZOOM - move + /-
            - DIFFERENCE - turn momentarily on to disrupt texture / inhibit
- SOUND
    - Sound mix is set by the amount of each colour on screen. Therefore a fully red screen should trigger the corresponding sound sample at 100% volume / envelope width.
    - MEASURE COLOUR actor - analyses RGB values of current video feed
        - RGB values should be '0' when screen blank - if not, adjust contrast
        - LIMIT SCALE VALUE
            - Fill screen with each colour - measure level
            - Set corresponding LIMIT MAX to same value.

A3.0 Laptop Loop

A3.1 - Software Schematics



A3.2 - Hardware

- 6 x laptops*
    - Macbooks
- 6 x usb webcams*
    - Logitech Quickcam Pro 9000

** Number of laptops / webcams variable, depending on availability, but must be equal in order to create a 'node'. Initial tests were developed with 2 laptops / webcams, whilst the Feedback Forum used 6 x sets. Subsequent tests have worked with up to 16 laptops / webcams.*

A3.3 - Software

- Isadora (Troikatronix) - video processing / projection mapping (Mac / PC)
- Webcam Settings app (mac app store) - OPTIONAL - allows access to webcam white balance / exposure settings

A3.4 - Calibration

- SPACE
    - Space must be large enough to contain the Loop. Alternatively, the number of nodes can be scaled to fit space
    - As the feedback is screen-based, the space can be light or dark

- LAPTOPS
    - Arrange laptops in a circle, distributed equally by degrees (eg 6 laptops = 60 degree segments)
    - Each laptop faces the previous laptop (rather than centre of circle)
    - Open each screen to 90 degrees
    - Set each screen to same brightness level

- WEBCAMS
    - Each usb webcam is placed BEHIND the connected laptop, pointed

at the SCREEN of the next laptop in sequence to create a circle. For example, Webcam A is plugged into Laptop A, but is pointed at Laptop B. A>B>C>D>E>F>A

- Be careful not to move webcams once in position.

- SOFTWARE - ISADORA
  - PROJECTION MAPPING actor
    - Map projector INPUT to the corners of the next laptop screen (visible via the webcam)
    - Projector output should be fullscreen
  - SCENE TIMING
    - If using multiple scenes, link scene transition to computer clock to ensure all laptops jump to same scene at same time.

- SOFTWARE - WEBCAM SETTINGS (optional)
  - set webcam to manual white balance and exposure - use same setting on each camera.

APPENDIX B

FINAL FORMS:

ADDITIONAL IMAGES

B1 PORTAL

Additional videos at www.videointheabyss.smeech.co.uk

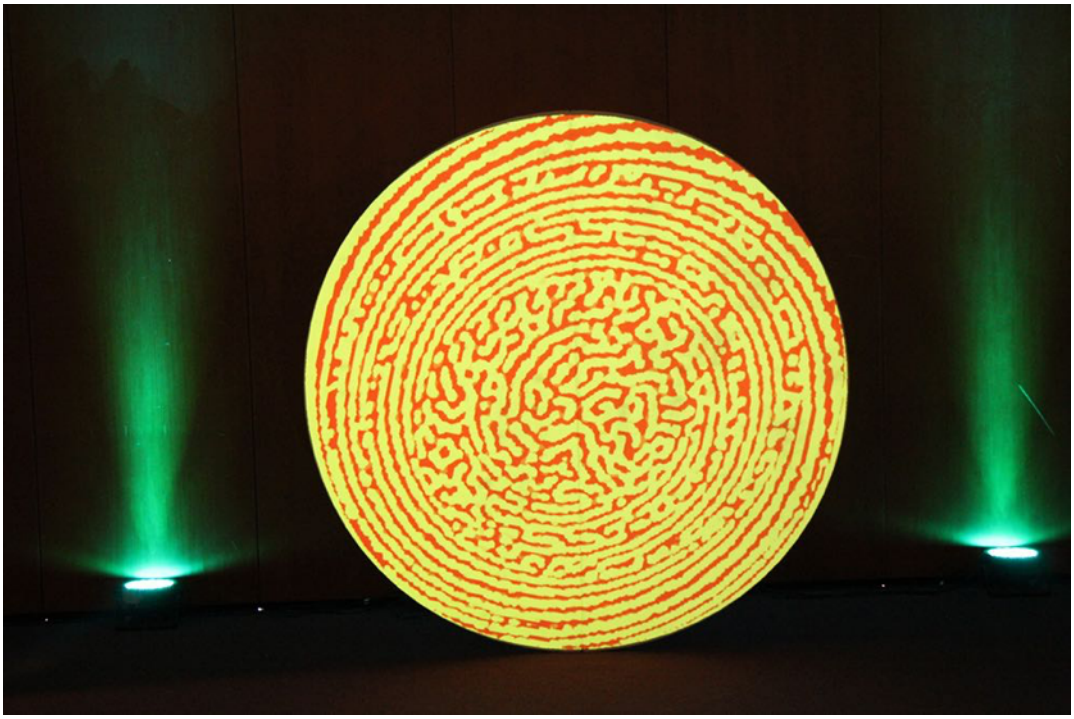


Figure B.1.1 - 'PORTAL' - Macclesfield Library, July 2019 , (Sam Meech, 2019)

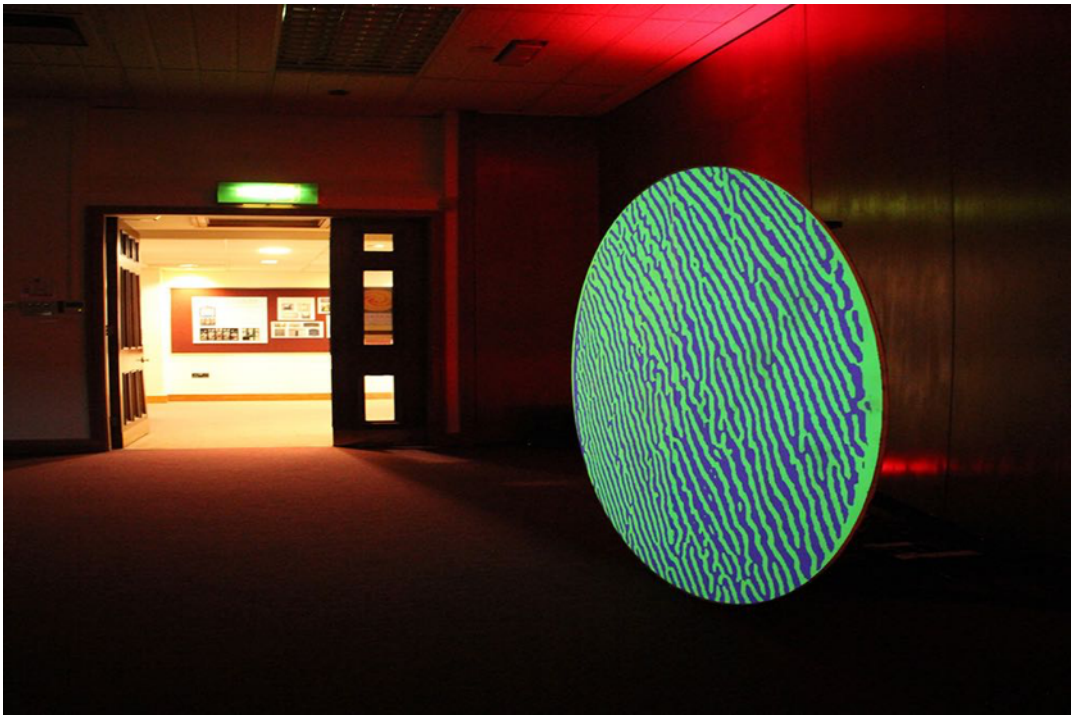


Figure B.1.2 - 'PORTAL' - Macclesfield Library, July 2019 , (Sam Meech, 2019)

Figure B.1.3 - 'PORTAL' - Rogue Studios, Manchester, July 2019 , (Sam Meech, 2019)

Figure B.1.4 - 'PORTAL' - Rogue Studios, Manchester, July 2019 , (Sam Meech, 2019)

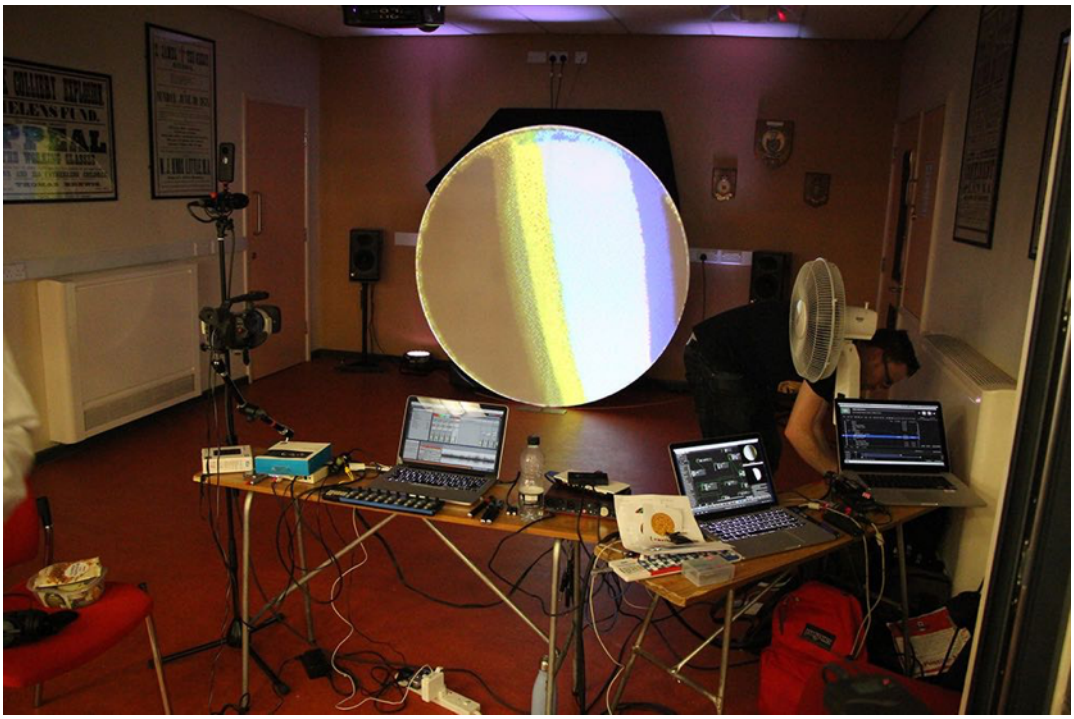


Figure B.1.5 - 'PORTAL' - St Helens Library, August 2019 , (Sam Meech, 2019)

Figure B.1.6 - 'PORTAL' - St Helens Library, August 2019 , (Sam Meech, 2019)

Figure B.1.7 - 'PORTAL' - Holden Gallery, Manchester, January 2019, (Sam Meech, 2019)

Figure B.1.8 - 'PORTAL' - Holden Gallery, Manchester, January 2019, (Sam Meech, 2019)

B2 Video Culture

Additional videos at www.videointheabyss.smeech.co.uk

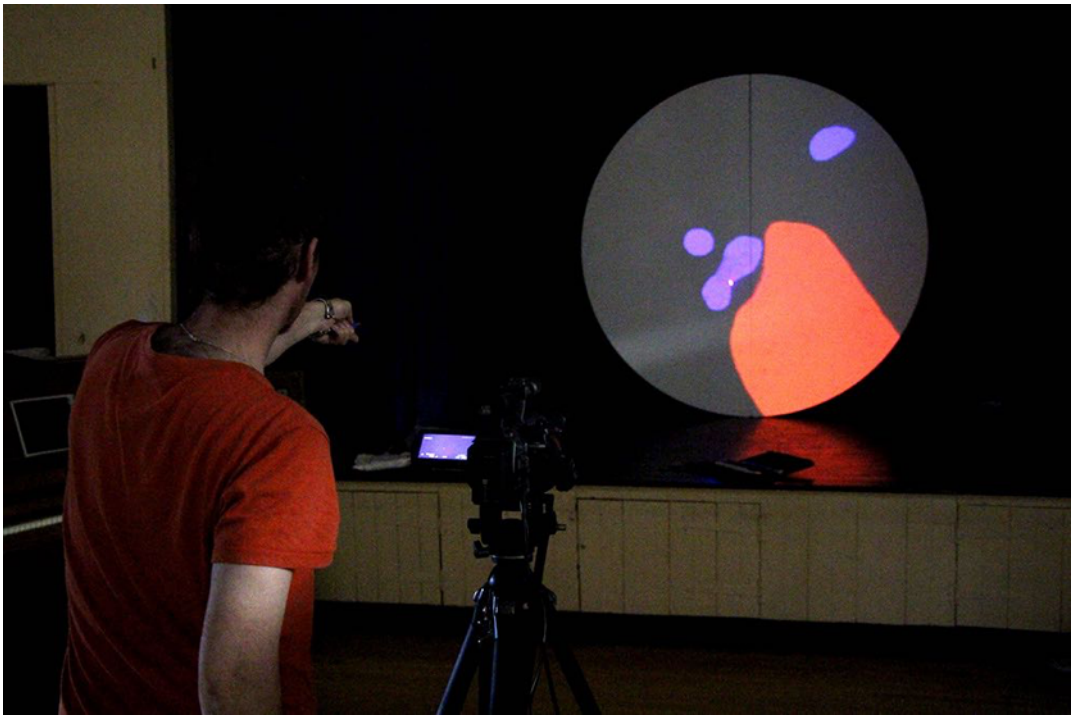


Figure B.2.1- 'Video Culture - test' - Rogue Studios, Manchester, July 2019 , (Sam Meech, 2019)

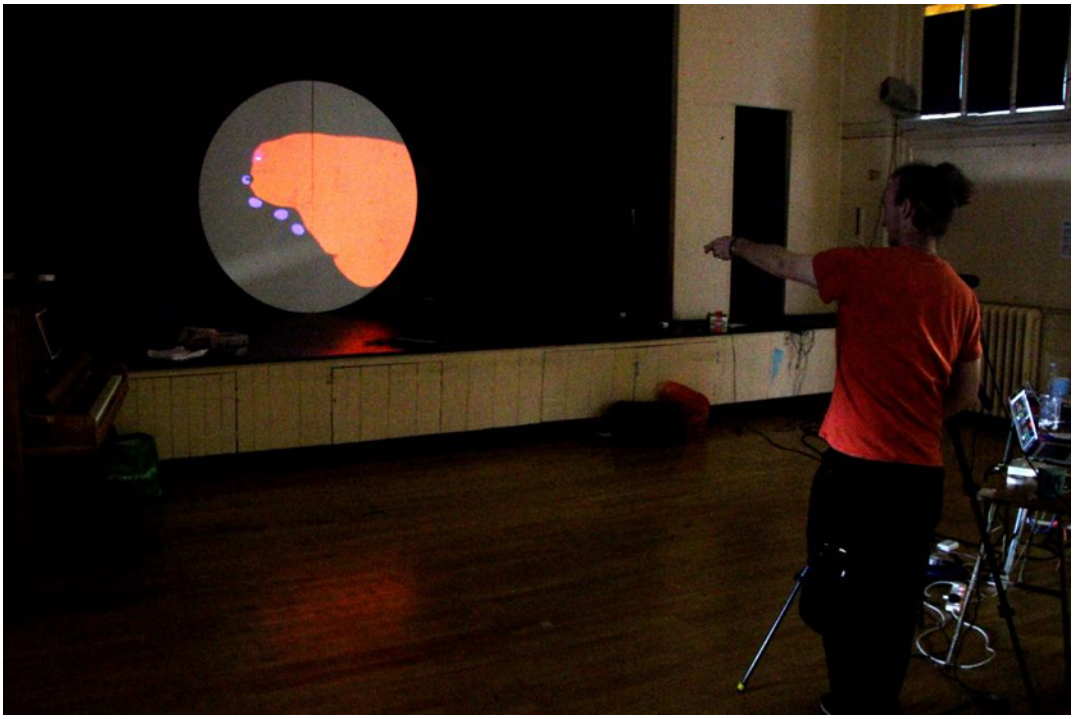


Figure B.2.2 - 'Video Culture - test' - Rogue Studios, Manchester, July 2019 , (Sam Meech, 2019)

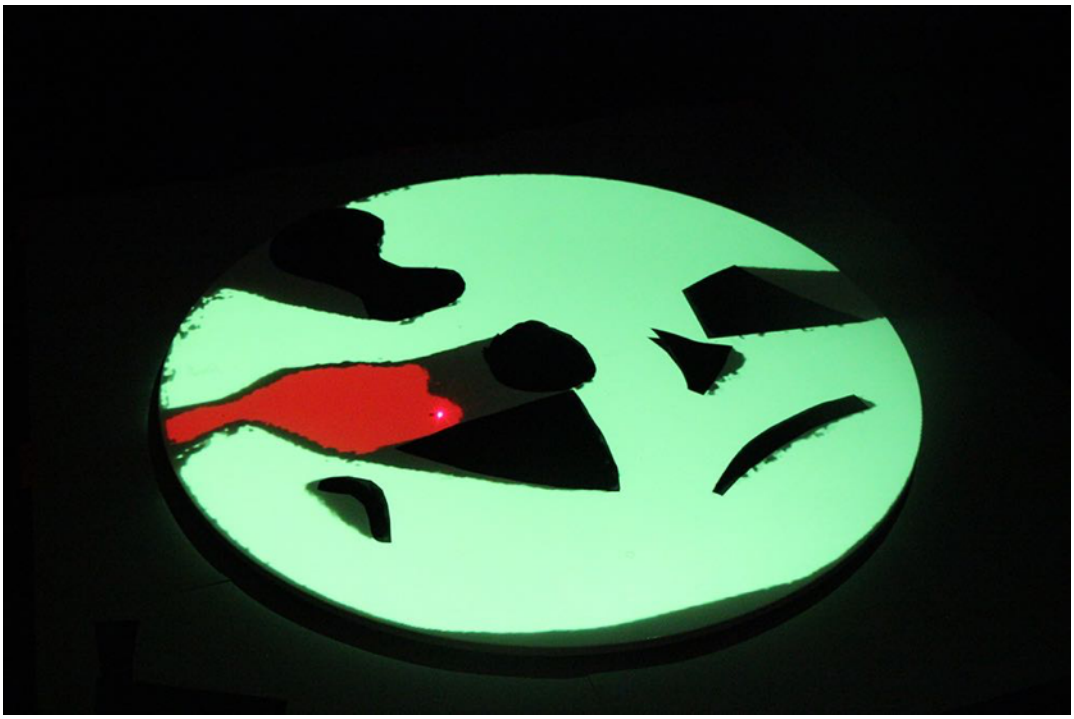


Figure B.2.3 - 'Video Culture - test with blocks' - Manchester School of Art, June 2019 , (Sam Meech, 2019)

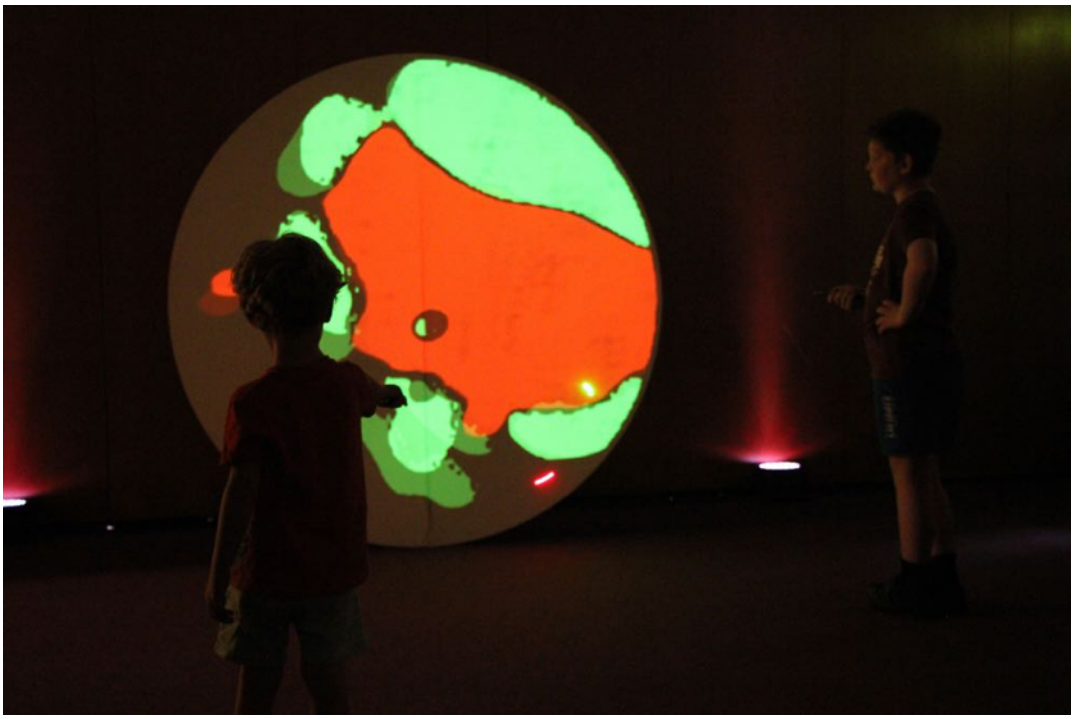


Figure B.2.4 - 'Video Culture' Macclesfield Library, July 2019 , (Sam Meech, 2019)

Figure B.2.5 - 'Video Culture performance' Holden Gallery, Manchester, January 2019, (Sam Meech, 2019)

Figure B.2.6 - 'Video Culture performance' Holden Gallery, Manchester, January 2019, (Sam Meech, 2019)

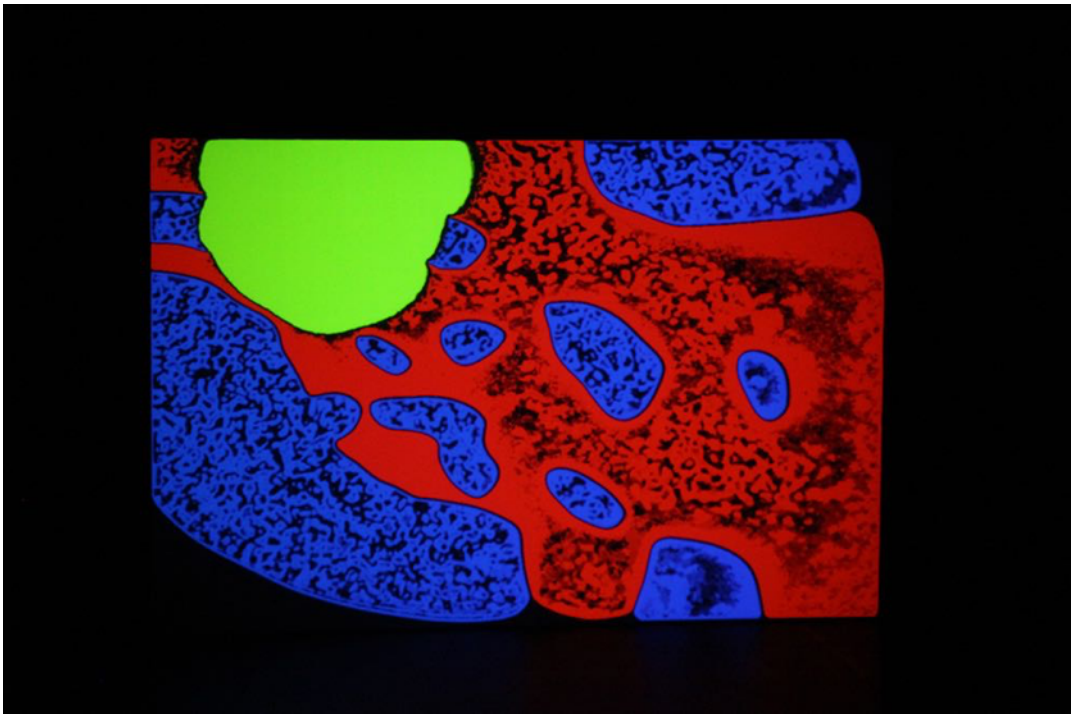


Figure B.2.7 - 'Video Culture test' Elastic Spaces Lab., Montreal, December 2019, (Sam Meech, 2019)

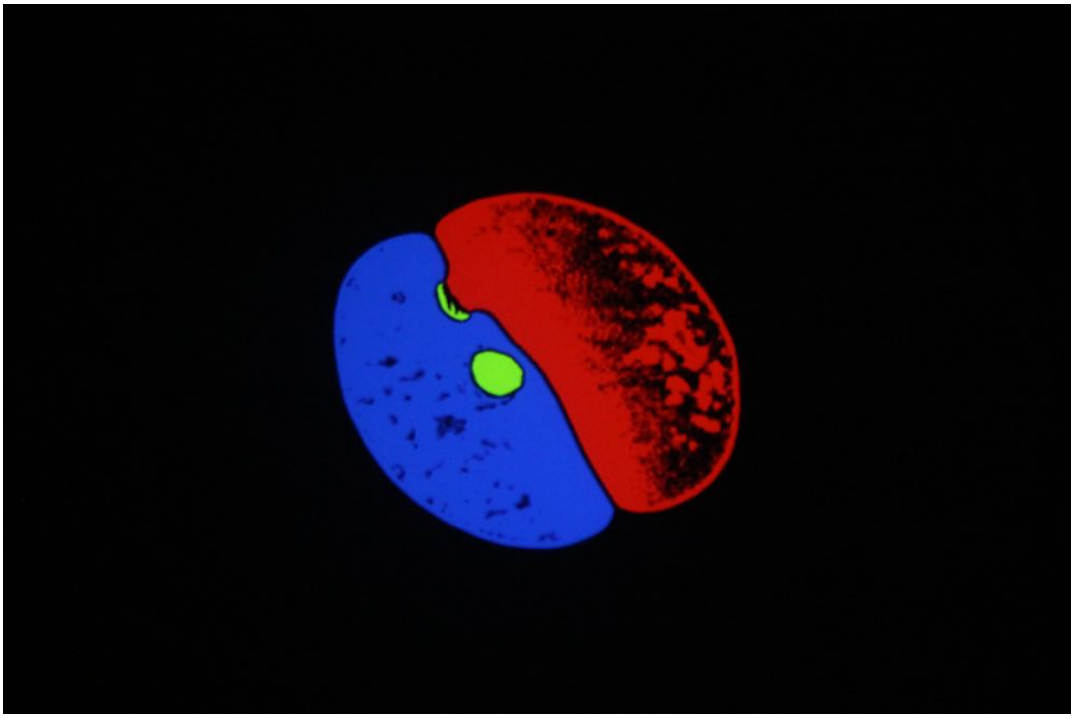


Figure B.2.8 - 'Video Culture test' Elastic Spaces Lab., Montreal, December 2019, (Sam Meech, 2019)

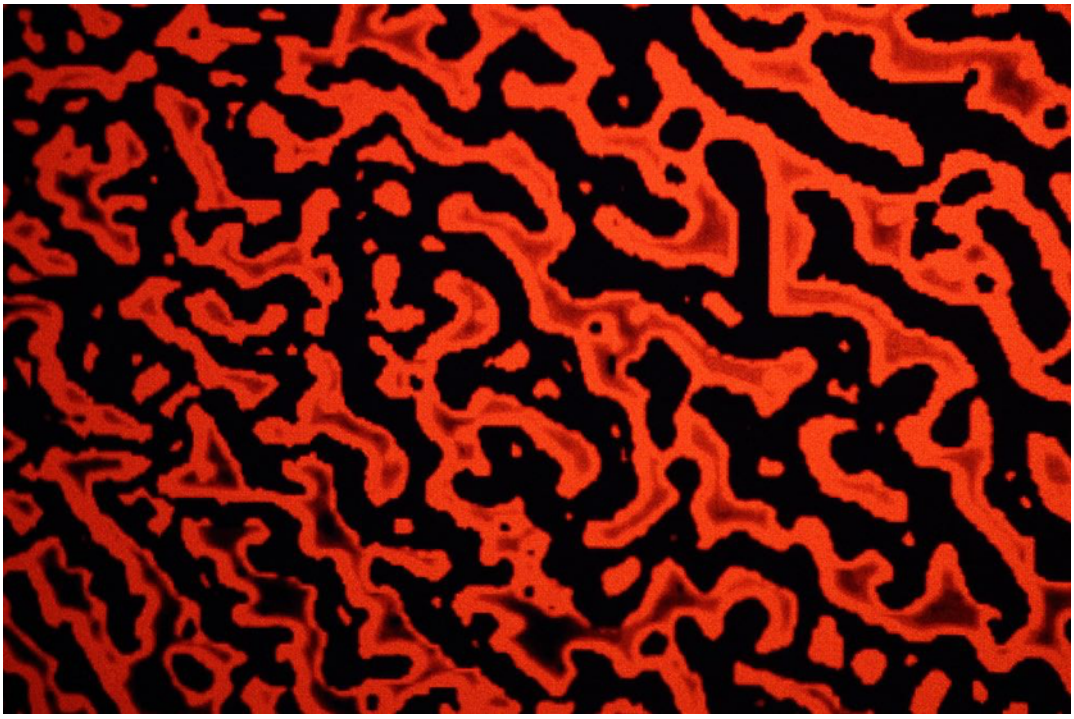


Figure B.2.9 - 'Video Culture test (detail)' Elastic Spaces Lab., Montreal, December 2019, (Sam Meech, 2019)

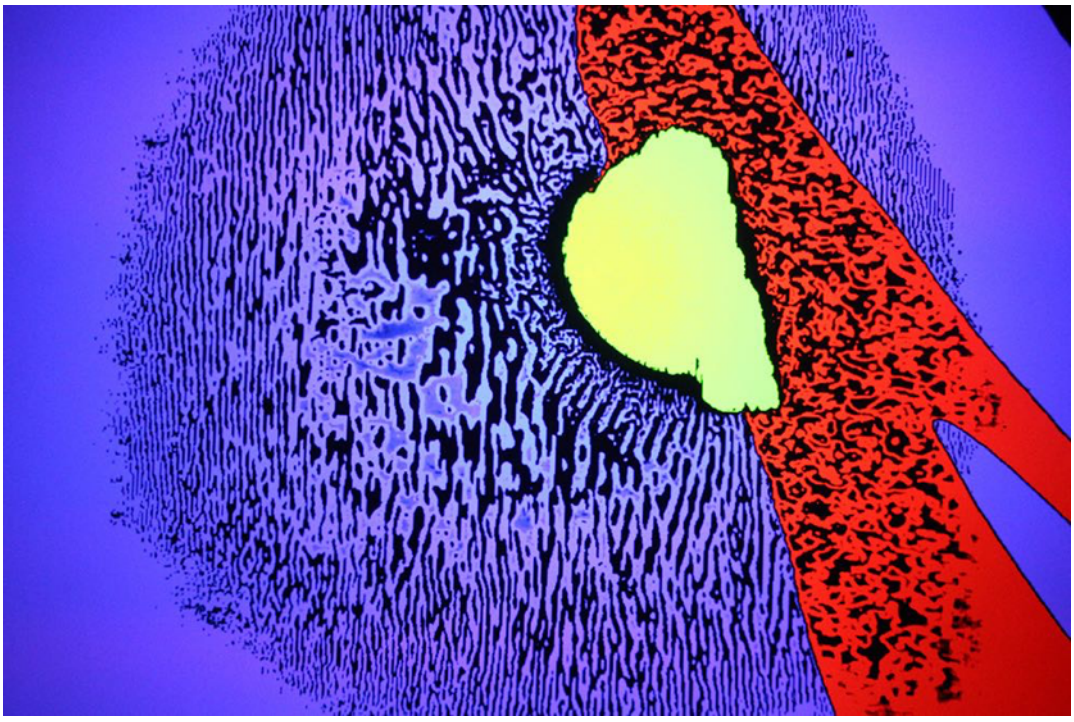


Figure B.2.10 - 'Video Culture test (detail)' Elastic Spaces Lab., Montreal, December 2019, (Sam Meech, 2019)

B3 Laptop Loop

Additional videos at www.videointheabyss.smeech.co.uk

Figure B.3.1- 'Laptop Loop x 16', (Sam Meech, 2019)

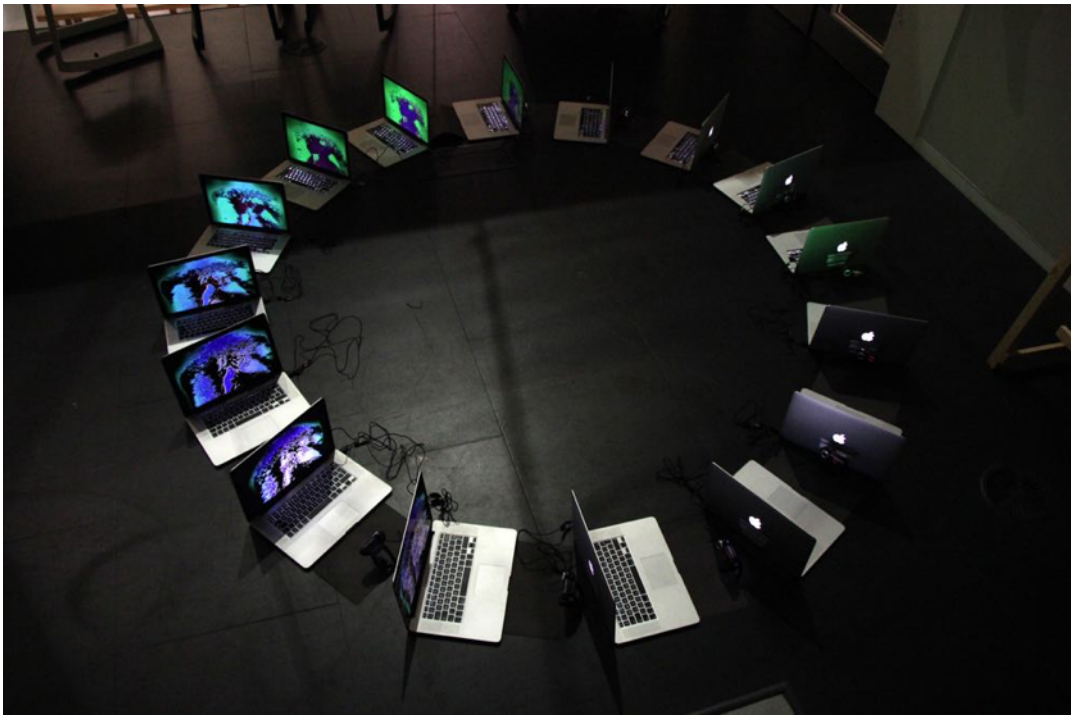


Figure B.3.2- 'Laptop Loop x 16', (Sam Meech, 2019)

Figure B.3.3- 'Laptop Loop x 16', (Sam Meech, 2019)

Figure B.3.4- 'Laptop Loop x 16', (Sam Meech, 2019)

Figure B.3.5- 'Laptop Loop x 16', (Sam Meech, 2019)

Figure B.3.6- 'Laptop Loop x 16', (Sam Meech, 2019)

Figure B.3.7- 'Laptop Loop x 16', (Sam Meech, 2019)

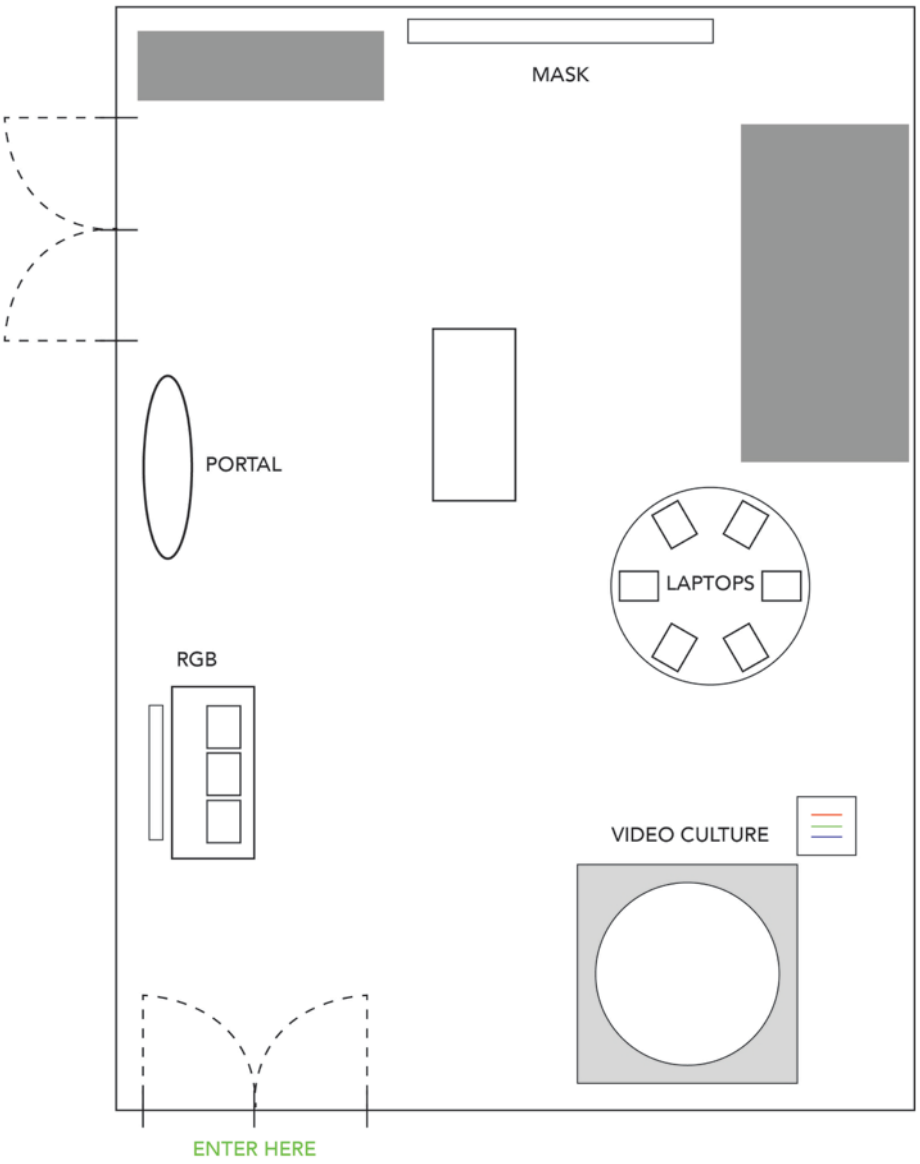
Figure B.3.8- 'Laptop Loop x 16', (Sam Meech, 2019)

APPENDIX C

FEEDBACK FORUM DIAGRAM

C1 Diagram of test installation

SAM MEECH - FEEDBACK / FORM - MRes test installation
Friday 28th June 2019 - BZ 3.09



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